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# THE TERMINAL ILEUM, APPENDIX, CECUM, AND ASCENDING COLON FROM THE STANDPOINT OF THE INTERNIST[1]

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THE fluoroscope and films are but two methods of obtaining diagnostic evidence. The most efficacious use of the roentgen ray occurs when the information supplied by it is given its proper evaluation in the general evidence elicited by all methods. Personal discussion with the roentgenologist as a consultant may lead to a better understanding of the findings. There should be a spirit of co-operation, not a spirit of rivalry or antagonism. The internist should, if possible, be at the fluoroscopist's side, or furnish him otherwise with *his* ideas of the position and character of the pathology, just as he should be at the side of the surgeon when the abdomen is opened. Although, of course, both the surgeon and the fluoroscopist must make their routine examinations, their sessions with the patient must, of necessity, be short. The internist can save much time, expense, and trouble for the patient by directing attention to areas under suspicion. It is this close contact which I urge. The sense of sight and touch of the fluoroscopist and of the surgeon may fail to elicit pathology which has been proved to be present through days or weeks of study by the internist.

The appendix is probably the most important anatomic part, first, because it is the most frequent serious cause of lower right quadrant distress (due to the urgency of early surgery); second, because of the much argued subject of chronic appendicitis, and, third, because of the frequent unnecessary removal of the appendix.

The very severe, fulminating case of appendicitis may be dismissed, because only rarely does it become necessary to use the roentgen rays. We must consider the subacute and chronic cases.

In both types, the symptom of greatest importance is rigidity, that is, involuntary muscle defense. Its presence in the right lower quadrant of the abdomen speaks for peritoneal irritation; in the absence of all other causes, it means an inflamed appendix. Having in mind the great length and varied positions which this organ may assume, it becomes necessary to exclude many other causes for pain and rigidity.

In the female, many ovarian (especially twisted pedicle of an ovarian cyst), tubal, broad ligament, and uterine conditions must be ruled out. In both sexes a long, inflamed appendix resting on the bladder or right ureter may suggest that the primary pathology is in the urinary system, even to the extent of showing blood microscopically in the urine. The appendix may extend to the left beyond the midline and, in a subacute attack, suggest an acute diverticulitis. Again

[1]Read before the Radiological Society of North America, at the Seventeenth Annual Meeting, at St. Louis, Nov. 30–Dec. 4, 1931.

it may extend upward, so that the pain and rigidity are in the upper abdomen, suggesting gall-bladder, duodenal, or gastric disease. Its presence posterior to the ascending colon and cecum may mask the anterior findings and produce such pain in the back as to suggest a kidney disorder. And so there are a multiplicity of conditions which may be simulated by acute and subacute appendicitis and, likewise, a multiplicity of other conditions which may simulate this disease.

*Rigidity* and local tenderness are the most important findings. They alone, when limited to the right lower quadrant, make surgery the safest course to pursue. Fortunately, however, there are usually associated symptoms, such as slight rise in temperature, rising leukocyte counts, slight nausea, vomiting, right psoas muscle spasm, pain on jarring, and so forth. In children presenting acute infections or pneumonia with diaphragmatic pleurisy, rigidity may be present and is to be differentiated. A film of the lung may be helpful. In the acute and subacute and chronic attacks, the roentgen ray aids best by assisting in the exclusion of other causes.

The chronic type of appendicitis is probably the most confusing to the internist, surgeon, and roentgenologist, especially so in the presence of chronic colitis. However, patients with the chronic type have, in the course of the disease, *attacks* of varying degrees of severity associated with localized pain and tenderness which, with the fluoroscope, may be definitely attributed to the appendix, if the latter can be filled. When it cannot be filled, a tender spot outside the area of the cecum may be attributed to the appendix, if all other causes are excluded. Such mild attacks can better be attributed to an inflamed appendix, if the pain is aggravated by those factors which mechanically irritate an inflamed peritoneal surface, such as jarring, bending, coughing, and contraction of the iliopsoas muscle. The pain may extend into the thigh. When the distress continues for from 48 to 72 hours, it is more suggestive of an inflamed appendix. The finding of a slight rise in temperature and gradually increasing leukocyte count, with rigidity, would complete the diagnosis. It is to be remembered that occasionally a long appendix, extending low into the true pelvis, when it is mildly inflamed, may produce atypical symptoms, which, for years, are inadequately explained. Yet, during an attack, a rectal digital examination may reveal a constant point of marked local tenderness. When it is found, a film should be made, for a fecalith with calcium content may be revealed.

In these chronic cases, the mildness of the symptoms permits a more extensive roentgenologic study. Especially when the patient is seen between attacks the roentgen ray is of great value, aiding markedly in the process of elimination, until no anatomic part remains to be accused except the appendix. Here the history of attacks, with apparent freedom from distress between, is suggestive of appendiceal disease. It is my custom to make a plain film of the genitourinary tract, examine the stomach fluoroscopically, and follow the barium through to the ascending colon, especially observing the terminal loops of the ileum, ileocecal valve, cecum, and appendix. This is followed by a colon fluoroscopy from below. The finding of a kinked, tortuous, beaded, fixed appendix, with tenderness localized on rolling only the appendix, would fit in with our suspicion that it is pathologic. The finding of a calcified fecalith in the appendix would support this. A kinked and tortuous terminal ileum would speak for adhesions.

The picture is further complicated, and the difficulties of diagnosis multiplied, if these mild attacks occur in individuals suffering with chronic colitis, having some abdominal distress daily due to a crampy colon. This is the individual who so often comes to the internist with the appendix removed.

still having pain. To be sure, it is better to remove nine normal appendices than to leave one which is diseased. In these cases the cecum, ascending, transverse, descending colon, or sigmoid are usually tender to deep palpation, and cramping may be seen fluoroscopically with, or without, pain. The sigmoid may extend to the right, causing pain in the right lower quadrant. Careful questioning reveals the use of abnormal irritants, such as cathartics, laxatives, enemas, indigestible oils, or it may be the use of foods injudiciously chosen for quality and quantity.

These patients give the history of abdominal distress associated with the desire to go to stool, softer stools than normal, alternating with harder ones. Flatulency and rumbling noises are noted. The cramping of the colon may be severe enough to cause nausea and vomiting, which, however, are promptly relieved by evacuating the colon. The barium enema may reproduce the nausea and pain. It is in these cases that I would stress the value of correcting the colon difficulty by diet, drugs, vaccine, psychiatry, etc., before formulating an opinion of the appendix. Get the bowel movements normal; stop gas production, and thus soothe the colon. If, in the course of perfectly normal stools, an attack of abdominal pain occurs, the analysis is simplified, for there is but one type of pain, the colon pain having subsided. If, however, the recurrence of pain is associated with softer stools than normal, an increase in gas production and expulsion, the pain relieved somewhat by passage of stool and flatus, we have fair proof that we are dealing with colitis. The removal of the appendix will not help this situation. Here, the tenderness may be present not only over the cecum and ascending colon, but also over other parts of the colon, especially that part of the descending colon which can be rolled against the wing of the left iliac bone.

Very rarely, in attacks of severe abdominal pain due to gallstones, appendicitis, or disease of other abdominal organs, loose stools do occur, probably due to reflex psychic stimulation of the colon. The colon may thus falsely be held accountable for the primary cause of the pain. The distinguishing features of this diarrhea are its late onset after the onset of pain (the pain preceding the diarrhea by from two to eight hours or more), and the failure to gain relief from pain following defecation. These points suggest other cause than the colon. Pain, nausea, and vomiting attributable to colitis, if associated with diarrhea, are usually very soon followed by loose bowel movements. Relief from all these symptoms soon follows evacuation of the colon in most instances.

Thus, a small proportion of the chronic, repeatedly mildly inflamed appendices are diagnosed indirectly by the process of exclusion. Surgical intervention should be undertaken in the acute flare-up, since the patient is then more amenable to suggestion. However, in certain patients, it may be advisable to operate in the quiescent stage because of contemplated trips to regions in which emergency surgery is not available.

Let me emphasize, when *rigidity* is present with local tenderness, not a moment should be lost in time-consuming tests. Such an abdomen is surgical, when extrinsic causes are excluded.

Carcinoma of the ascending colon may reach considerable proportions before producing subjective symptoms. The bowel here is rather wide and its content fluid, thus signs of obstruction are late in appearing. The best means for early diagnosis are the fluoroscope, films, chemical examination of the stool for blood, and palpation.

Hypertrophic tuberculosis, hardly to be diagnosed except by the microscopist, is to be suspected in known cases of pulmonary tuberculosis with non-annular filling defects in the ascending colon. The same holds true for the ulcerative type.

While rare on the right, diverticulitis may

Fig. 1. An annular carcinoma of the cecum just above the ileocecal valve.

occur in a sigmoid lying to the right or in the the ascending colon. A previous knowledge of the presence of such diverticula may justify a suspicion of the diagnosis of diverticulitis, but it would be safer to operate. Polypi in the ascending colon or in the sigmoid, lying in the right lower abdomen, may be the cause of right lower quadrant pain.

The terminal ileum is rarely the seat of chronic disease. The more frequent clinical conditions are adhesions to the pelvic organs (in the female) and the appendiceal region, or anterior abdominal wall scars, often with mild, repeated, or severe acute attacks of obstruction. Rarely, papillomas occur in the terminal portion of the ileum. Also Meckel's diverticulum must be sought. Primary tumors in the ileocecal valve or adjacent regions may cause the same clinical picture. Here the careful analysis of the distress picture is most fruitful. It reveals a series of abdominal pains, each series made up of one or more cycles, each cycle characterized by two or more mild or severe cramp-like pains coming at intervals of a few minutes, culminating perhaps in a gurgling, squirting sound, only to be repeated a few minutes or hours later. These attacks may be months or years apart, daily or hourly, severe or mild, depending upon the cause and degree of obstruction. When they are seen early in an attack, there may be no abdominal distention, no visible or palpable peristalsis, *yet a film of the abdomen may reveal a distended loop of ileum in the pelvis or elsewhere,* adding further weight to the suspicion of obstruction. When justifiable, the obstructive symptoms being of a very mild character, and the colon having been excluded as the site of the lesion, barium may be followed through to the cecum. A thicker terminal ileum shadow (*i.e.,* denser than usual) with loss of valvulæ conniventes markings, and hyperperistalsis, suggest obstruction at the ileocecal valve. I would advise the careful scrutiny of the terminal ileum and this valve in fluoroscopy of the colon, and more follow-through observations in cases presenting obscure signs in the right lower quadrant.

### CASE REPORTS

Case 1 (Fig. 1). C. B., white, male, aged 40 years, druggist, came to me in August, 1924, complaining of cramping abdominal pain and diarrhea which had persisted for two months, fullness, and pressure, especially in the right upper and lower quadrants, and the loss of 10 pounds in weight. He had two or three bowel movements a day—mushy, gruelly, or watery—with much spattering of stool and excessive quantity of gas, followed by relief from pain. He attributed the onset to an attack of influenza six months previously. Except for atrophic rhinitis and slight bronchial asthma, there

Fig. 2-*A*.

Fig. 2-*B*.

were no other findings. Examination revealed a small nodular mass about the size of a hazel-nut in the right lower quadrant in the region of the ileocecal valve. There was slight tenderness here at times. Definite stiffening of the bowel could be felt to come and go under the fingers, yet distress disappeared upon stopping all fermentation and obtaining normal stools. No gross blood was seen.

Colon fluoroscopy showed marked evidence of spasm in the descending colon, also an obstruction which remained as a narrowed region just above the ileocecal valve. Barium finally entered the cecum, filling it and the terminal ileum. The mass palpated corresponded to the narrow region in the ascending colon. This mass, which was resected by Dr. Dean Lewis in November, 1924, was found to be an annular carcinoma of the cecum just above the ileocecal valve. The patient is alive, with no recurrence at this date.

Case 2 (Figs. 2-*A* and 2-*B*). H. M. L., white, male, aged 59 years, a manufacturer, was seen in 1925, when the following diagnosis was made: colitis, maxillary sinusitis, and slight chronic splenic tumor due to malaria.

The patient returned Jan. 12, 1927, complaining of a mass in the right lower quadrant of the abdomen, gross blood in the stools, and bloodshot eyes. The mass, which was located in the cecal region, was moderately firm and could be moved up and down for a distance of two or three inches. It elevated the abdominal wall slightly and was considered as a possible pedunculated polypus because of its mobility.

The blood count showed 9,420,000 red blood cells, 16,500 white blood cells, and 110 per cent hemoglobin. The differential count showed 90 per cent polymorphonuclear neutrophils, 5 per cent small mononuclears, 4 per cent large mononuclears, and 1 per cent transitional cells.

The spleen had enlarged from its former position, above the rib margin, to extend two fingers' breadth below. Colon fluoroscopy revealed a rounded, somewhat mottled

Fig. 3. Case of right lower quadrant pain.

Fig. 4. The terminal portion of the ileum was adherent in the pelvis to the right tube: there was no acute inflammatory process.

filling defect within the lumen of the cecum, elicited only by pressure. The mass felt corresponded to the filling defect and could be pushed up in the ascending colon a distance of from 2 to 3 inches. The margins of the cecum and ascending colon were normal, as were the ileocecal valve and terminal ileum.

We diagnosed polycythemia vera (erythremia), a pedunculated polypus of the ascending colon, with torsion, gangrene, and sloughing, and, in addition, Buerger's disease of the right lower extremity, the findings of which were typical.

There was no operation. This patient has been observed frequently, and no evidence of his polypus remains at the present time. The polycythemia is adequately taken care of by a roentgenologist, and the symptoms of Buerger's disease have disappeared.

Case 3 (Fig. 3). This case illustrates how a right lower quadrant pain may be due to the sigmoid.

E. M. L., white, male, aged 56 years, a teacher, came to me on June 4, 1924, complaining of a "grating" pain of eight years' duration in the right lower quadrant, and diarrheal stools intermittently for 17 years. The grating sensation in the right side was not relieved by the passage of stool or gas, but might be relieved by a five-minute rest, or by a hot-water bag. It was not a real pain, but a discomfort. At intervals, blood had been seen in the stools, which were always soft, for a period of about nine years. The rest of the history was negative. Passage of normal stools did not relieve the grating pain.

The first fluoroscopic examination of the

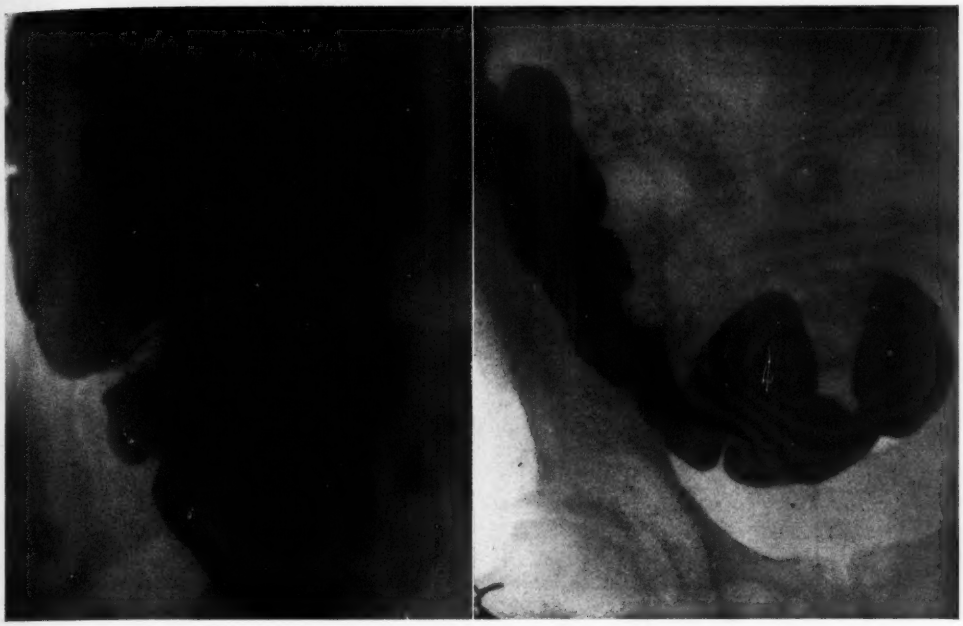

Fig. 5-*A*.

Fig. 5-*B*.

colon revealed nothing, but a film showed the sigmoid to extend to the right almost to the cecum. In one portion of the sigmoid, a slightly decreased density of the opaque medium was noted. A polypus was suspected and re-examination advised. Repeated fluoroscopies of the colon indicated a definite filling defect limited to this same region. The width of the lumen of the bowel was not affected. Diagnosis of a bleeding, pedunculated polypus was made, and verified at operation by Dr. Dean Lewis.

Case 4 (Fig. 4). This case illustrates the value of films taken before the introduction of a contrast medium in abdominal pain of obstructional character.

P. McM., white, female, aged 28 years, married, had been under my care for months because of complaint of a very irritable colon. On Jan. 1, 1929, she complained of an attack of pain in the *left upper quadrant*, quite different from any that she had had before, which was present for one hour and was associated with nausea. A few hours later the character of the pain spoke for intestinal obstruction. She entered the hospital, where a film of the abdomen was made. This showed a distended loop of small bowel above the navel and one in the pelvis. The abdomen, which was not distended, was quite comfortable between the attacks of pain. The attacks becoming more and more marked, with nausea and vomiting, the patient finally consented to an operation.

The terminal portion of the ileum was found adherent in the pelvis to the right tube. There was no acute inflammatory process. A lateral anastomosis was made by Dr. Edwin Miller, with complete recovery. It is interesting to note that the pain was first felt in the left upper quadrant.

Case 5 (Figs. 5-*A*, 5-*B*, and 5-*C*). W. C. P., white, male, aged 51 years, a judge, came to me on Nov. 21, 1926, complaining of diarrhea of three weeks' dura-

tion, and distress shifting throughout the abdomen. Seven years previous to the present examination, he had had a few subjective symptoms of what was thought to be ureteral colic, but examination of the urinary tract at that time was negative. Three weeks before I saw him, his pain again started in the right lumbar region, radiating to the lower abdomen midway between the symphysis and the umbilicus. This pain,

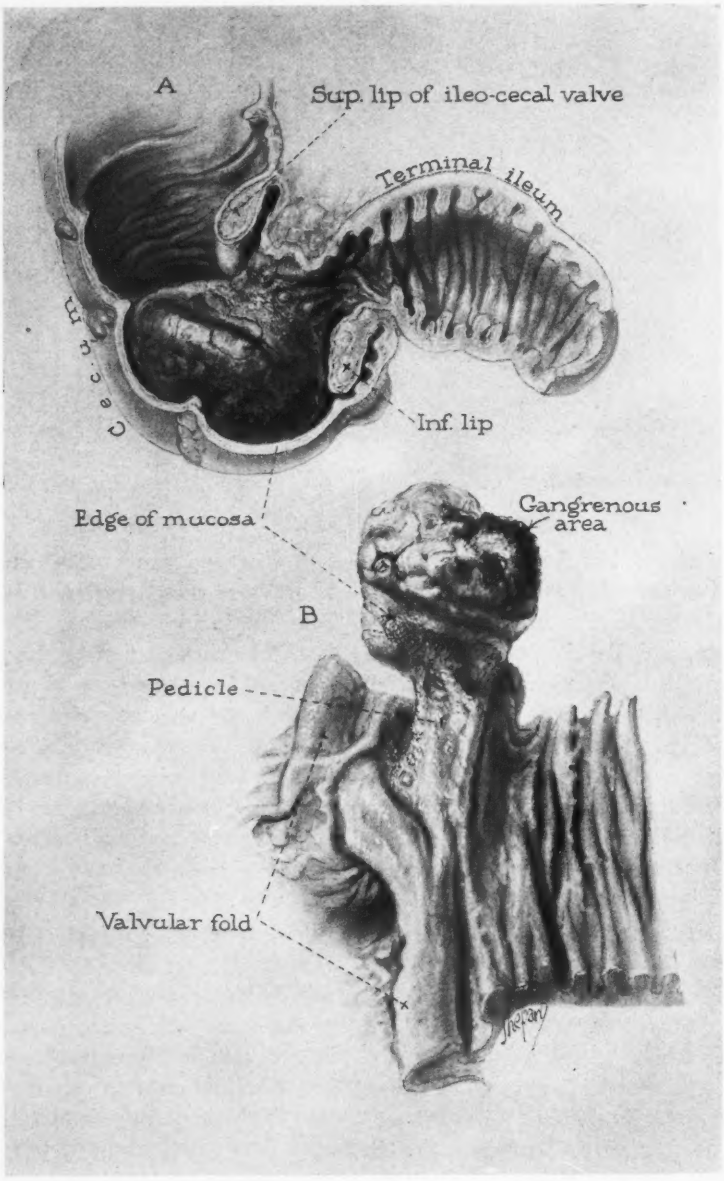


Fig. 5-*C*. A pedunculated lipoma, attached to the last inch of the ileum, had herniated through the ileocecal valve and become twisted and semigangrenous, with some sloughing.

which lasted for five or six hours, was relieved by morphine. One week later diarrhea began, with two or three watery stools daily. Red blood was seen in two stools. There was much flatulency, and the distress shifted from the ascending to the transverse and descending colon regions. Desire to go to stool was usually associated with abdominal pain. Except for tuberculous glands at eight years of age and tuberculosis of the left tibia, his history was negative. One brother had pulmonary tuberculosis and two children had tuberculosis.

The analysis of his abdominal pain showed that it was partly due to the colon. In the lower abdomen there was, in addition, a rhythmic type of pain, very mild in character, which suggested a low-grade obstruction, probably in the lower ileum. He was very fat so that palpation was difficult. The Wassermann test and blood counts were negative. A genito-urinary film showed prostatic calculi, and fluoroscopy of the colon showed marked spasm throughout. In addition, there was a constant marked incisura on the lateral aspect of the ascending colon, opposite the region of the ileocecal valve and its frenulum, a decreased density in this region, and a peculiar contracted condition of the cecum.

Next, a follow-through fluoroscopic and film examination of the ileum was made. This revealed stasis in the terminal ileum, evidenced mainly by a denser column of barium than usual (not widened), loss of the valvulæ conniventes (plicæ circulares), and a marked hyperperistalsis. Based upon all this evidence, a diagnosis was made of intestinal obstruction by a tumor in the region of the ileocecal valve. Dr. A. D. Bevan removed the terminal ileum, cecum, and a portion of the ascending colon. Upon opening this, a pedunculated lipoma was found attached to the last inch of the ileum. It had herniated through the ileocecal valve, and become twisted and semigangrenous,

Fig. 6. Case in which postmortem revealed an annular adenocarcinoma of the terminal inch of the ileum and ileocecal valve.

with some sloughing, which accounted for the red blood seen in the stool.

Case 6 (Fig. 6). Mrs. P. W., white, aged 83 years, was bed-ridden, due to a partial stroke, when she was first seen in December, 1929. In addition to heart block, the patient had had intermittent attacks of pain in the abdomen for six months, which, during the last two months, had occurred daily. Although the pain was usually in the right side below the navel, it might start in the left side and proceed to the right. The patient thought the pain was relieved by the passage of flatus, of which there was a great quantity. Bowel movements always had been loose. The abdomen had been gradually becoming larger.

Examination of the abdomen revealed very definite peristaltic stiffening of what appeared to be loops of the small bowel. The diagnosis was small bowel obstruction, probably due to carcinoma in the region of the ileocecal valve.

Colon fluoroscopy was negative. No barium entered the ileum. Because the obstruction was slight and was in a region in which the bowel content is watery, it was considered safe to give a small amount of barium by mouth. The fluoroscope showed a distinct constant narrowing of the last

inch of the ileum, with loss of the typical arrow-shaped ileocecal valve region shadow. In addition, the last portion of ileum showed a denser column of barium than normal, loss of the normal plicæ circulares markings, and severe hyperperistalsis. Operation was refused. Postmortem revealed an annular adenocarcinoma of the terminal inch of the ileum and ileocecal valve.

### CONCLUSIONS

I would stress the importance of the internist's co-operating with the roentgenologist as a consultant, not only on paper but by personal visits to the department in the hospital or clinic group. The experience will be mutually beneficial, as well as profitable from the patient's standpoint.

The patient with definite evidence of colitis, but questionable evidence of appendicitis, should have the former condition cleared up. During this treatment, close watch can be kept for any attacks of appendicitis.

Patients having abdominal pain of obscure origin should have films made of the abdomen prior to the introduction of a contrast medium.

The Graham-Cole gall-bladder dye test is now so easily given orally, and so often reveals pathology which has caused obscure or non-subjective symptoms, that it has become almost routine in my service for patients who have suffered attacks of abdominal distress or who have had vague symptoms referable to the stomach or bowel.

It is also suggested that more small bowel fluoroscopies be done in cases showing negative colon examinations but presenting lower abdominal pain which is not otherwise explained. The internist is advised to study the character of the pain present in each attack, in an endeavor to elicit that type which is characteristic of intestinal obstruction.

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*A Powerful X-ray Tube.*—At two great electrical laboratories in America, the California Institute of Technology, in Pasadena, California, and the General Electric Company, at Schenectady, New York, 1,000,000-volt X-ray tubes are soon to be available for therapeutic use. Dr. C. C. Lauritsen, of the California Institute of Technology, estimated that the 550,000-volt two-kilowatt X-ray tube now temporarily diverted from physical research to experimental treatment of cancer cases is equivalent to at least 100 grams of radium, which, if they could be obtained, would be worth six million dollars. In a new radiation laboratory Dr. Lauritsen and his associates are now building an X-ray tube to operate at 1,000,000 volts. This will produce hard, penetrating rays that all the radium in the world could not produce, and the physicians working with the physicists will be able to direct the output of this most powerful tube at a single case of cancer if research during the next few years shows that to be desirable —*Science Service.*

# PROTECTION IN ROENTGEN THERAPY[1]

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THE question of protection in roentgen therapy is so important that, even though the subject has been well covered by such men as Pancoast (1), Wood (2), and Taylor (3) in this country, and Glocker (5), Bouwers and van der Tuuk (6), and Herrmann and Jaeger (4) in Europe, it seems worth while at this time to re-emphasize some of the salient points. The subject has been so adequately covered by these authors that I shall not emphasize location of the laboratory, electrical protection, or even primary radiation protection as built into the department. The Advisory Committee on X-ray and Radium Protection, which has issued a long series of very valuable recommendations, gives a table of lead protective equivalents for voltages from 75 to 600 kilovolts. Even though these recommendations are followed as closely as possible, tests should be made to ascertain if protection is being afforded. This can be done by the operators carrying dental films for several weeks at a time and by having adequate blood examinations made every few months as an additional check-up.

In the treatment of malignant disease by X-rays, more and more radiation is being applied as we realize that only with sufficient dosage can we successfully combat this condition. It, therefore, becomes increasingly important that the patient be protected from all stray radiation and that only the area which it is desired to treat actually receive the ray. In the use of voltages up to 140 K.V., it is quite common to employ the open glass bowl as a shield against stray radiation. However, there are so many places and so many directions from which the rays can leave the tube that one must be exceedingly careful to give the patient sufficient protection.

For example, in tilting the tube to accommodate an exposure about the head or neck, one can easily place the tube stem in such a position that rays will escape from the bowl through the notch which receives the tube stem. These escaping rays, which are necessarily unfiltered, may cause, in treatments of considerable duration, undesirable and exceedingly troublesome roentgen irritations. The result may be epilation or even superficial ulceration. One way to avoid these consequences is to cover the patient entirely with lead rubber or to have an adjustable, lead-covered frame which can be placed entirely over the patient, except for the field which is being treated. It is not pleasant nor always desirable, however, to cover the patient's head—one always runs the risk of giving undesired radiation in this region. Careful positioning of the tube stem will in part obviate this danger, but the possibility of damage is always present. Another way to help is to cut out flaps of lead rubber and hang them on the tube stems so that they cover the notches in the glass bowl, thus relieving oneself of considerable concern. But the best way to eliminate all possibility of serious damage from stray radiation from an open-bowl-enclosed tube is either to eliminate the bowl and enclose the tube in a lead container or to confine oneself to treatment of conditions requiring relatively small amounts of radiation.

In the use of voltages higher than 140 K.V., it is advisable to have the tube entirely enclosed in lead, except for the opening through which the primary beam emerges and is directed upon the patient.

[1]Read before the Radiological Society of North America, at the Seventeenth Annual Meeting, at St. Louis, Nov. 30–Dec. 4, 1931.

Adjustable or non-adjustable lead drums, self-protective tubes, the treatment couch, or the "slanting wall" can be used to secure electrical protection, except in the case of the open self-protective tube. By the use of such apparatus, one can confine one's vigilance to the placing of proper filter and the control of the other factors. The use of pressure cones, such as those devised by Holfelder, Wintz, and others, relieves one of the uncertainty of target-skin distance and field size; thus these cones are a protection both to patient and roentgenologist.

Since a large proportion of roentgen injuries are caused by omission of the proper filter, every precaution possible should be taken to prevent such a disaster. The use of colored tapes on various thicknesses of filter, each color representing a definite filter material and thickness, is of great value. One should have beside the window through which the patient is observed a list of the filters and their corresponding colors. Relays which prevent the closing of the X-ray switch if the filter is not in place are also of value, and one may have electric bulbs which light when the filter is in place and indicate which filter is in position. For use in the open bowl, a combination of colored tags and a double hook, which is attached to a minimum filter and through which connection is made between the anode and its connecting wire, has been found to be of very great assistance. With this, the current will not pass through the tube unless a hook is available—and a hook is not available unless a filter is in hand. This double hook was suggested by Holzknecht. If the technic is uniform, the filter can be screwed or locked in place.

In addition to all these visual, electrical, or mechanical checks on filter position, one must use eternal vigilance, since any one of them may possibly fail. When the factors for a particular treatment are determined and all settings made, a complete and accurate record should be made and signed by two responsible persons, one of whom must be a physician. Under no conditions should the checking of filter, distance, field, and time become a matter of mere routine, for, if it does, the value of the procedure is at once lost. When a long series of treatments is being given, it is well to tell the patient what color his or her filter carries.

For the laboratories which can afford it, an X-ray intensity indicator, or a dosimeter, is advisable as an additional filter control.

I should like to emphasize at this time the importance of accuracy of roentgen dosage as a protection, not only to the patient, but to the roentgenologist as well. With well calibrated apparatus, recalibration of which should be done at least once a month or whenever a tube is changed or rectification altered, one can much more easily ward off any possibility of suit in case a patient becomes litigious.

Whenever possible, uniform technic should be used, the variable factors being kept down to a minimum so that considerable automatic protection may be afforded. On any particular machine, kilovoltage and milliamperage should remain constant; distance and field can automatically be cared for by the use of proper cones. That leaves only dosage, preferably in r—controlled by time factor and filter—to be determined.

Since the utilization of the roentgen ray in the treatment of malignancies is, of necessity, being carried more and more to the point of definite skin reaction, it is wise to face this fact and to caution the patient beforehand what may be expected. Properly controlled skin reaction—and here accurate calibration is of great value—need cause the roentgenologist no alarm since there is usually *restitutio ad integrum*. If sequelæ ensue, they are of minor importance compared with the original condition for which the patient was treated. If a patient is approached properly, there is usually no difficulty in explaining the situation, especially if the approach is made before treat-

ment is begun. At this time, also, the patient should be given instruction in the care of all irradiated areas so that they will not become unduly irritated. The use of the word "burn" should be avoided entirely since it has come to have in the lay mind, as well as in that of a considerable part of the medical profession, an ominous and sinister meaning when coupled with either X-rays or radium. Possible changes in the fertility of women in the child-bearing age should also be discussed with the patient or a responsible member of her family.

SUMMARY

In considering protection, several points are emphasized: (1) methods of filter control, (2) treatment factor records, (3) accurate calibration of apparatus, and (4) complete understanding with the patient of superficial reactions and other changes due to the irradiation.

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*Single Cosmic Rays Detected by New Instrument.*—Cosmic rays plunging to earth from the depths of outer space are recorded unambiguously in a 15-foot iron tube detector, Dr. W. F. G. Swann and Dr. J. C. Street, of the Bartol Research Foundation of the Franklin Institute, stated in April before the American Physical Society.

About four times each hour the cosmic rays travel the whole length of the nitrogen-filled tube and cause a spurt of electrical current that Dr. Swann and Dr. Street find is twenty times that caused by the passage of an alpha particle or heart of a helium atom. They have thus obtained direct evidence that the cosmic radiation occurs in individual packets and that it might be considered a series of bullets with high energy.

In their measurements of the cosmic rays with the 15-foot tube, Dr. Swann and Dr. Street found evidence of radiations that are even more electrically exciting than the cosmic rays. Spurts of ionization current larger than those caused by the cosmic rays were consistently recorded. They seem to be caused by something that happens inside the tube. Dr. Swann suggested that these unknown radiations may be the same as the rays discovered by Prof. G. Hoffmann, and attributed by him to the breaking down of the hearts of atoms in the wall of the iron tube.—*Science Service.*

# THE RETICULO-ENDOTHELIAL SYSTEM AND ITS RELATION TO THE ROENTGEN STUDY OF THE LIVER AND SPLEEN AFTER THE INTRAVENOUS ADMINISTRATION OF THORIUM DIOXIDE SOLUTION[1]

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THE recognition of pathologic changes in the liver and spleen has always been a stumbling block to the roentgenologist. With the aid of pneumoperitoneum, and even without it, to a limited degree, it is possible to recognize alterations in size and position, but not until recently has it been possible to show even gross alterations in structure.

Since the discovery of the roentgenographic gall-bladder function test by Graham and Cole, in 1923, numerous roentgenologists have noted an increased density of the liver a few hours after administration of the phenolphthalein salt. This phenomenon enabled Einhorn and Stewart to observe alterations of structure, due to metastatic carcinoma and cysts of the liver, which they reported in 1927. Although this test has contributed much to the diagnosis of gall-bladder disease, its contribution to the roentgen diagnosis of diseases of the liver has been practically *nil*.

In 1928, Radt, in his clinic at the University of Berlin, began work on the theoretic assumption that a colloidal material of sufficient atomic weight, when injected intravenously, might be taken up by the reticulo-endothelial cells in sufficient quantity to visualize the liver and spleen roentgenographically. They first used in animal experimentation a thorium dioxide preparation called tordiol. But tordiol is not a stable colloid and, for this reason, the danger of capillary embolus formation made it unfit for use in human beings.

Oka, a Japanese, investigated the properties of tordiol and its effect on animal tissues. He was unable to find any evidence of the substance in the excretions and proved that it was deposited in the cells of the liver and spleen.

Because of the possible danger from tordiol, Oka, and later Radt, used a somewhat similar preparation called thorium dioxide sol. After many months of experimentation, this was thought to be a perfectly safe medium. Animals that had been injected two years previously did not differ from others not injected, despite the fact that the substance remains stored in the tissues. The blood picture showed a slight temporary leukocytosis and a temporary decrease in hemoglobin content. Chemical examination of the blood showed no abnormality. Similar changes were found in human beings subjected to the test.

Twenty patients injected by Radt and six by Oka were observed over a period of months. No ill effects were noted except that, in occasional cases, several hours after injection, there appeared a slight transitory discomfort, slight tension of the limbs, chills, and slight rise in temperature.

They were able by this method to visualize clearly the liver and spleen and to show some of the structure of these organs. The size and contour of the liver and spleen were plainly visible. In several instances, such pathologic conditions as metastatic carcinoma and cirrhosis of the liver were correctly diagnosed.

Radt feels that this procedure is a valuable adjunct in the diagnosis of diseases of the liver and spleen, pointing out the possibility of diagnosing such abnormalities as

[1]Read by Thomas A. Groover, M.D., before the Radiological Society of North America, at the Seventeenth Annual Meeting at St. Louis, Nov. 30–Dec. 4, 1931.

echinococcus cysts, liver abscess, hemangioma, and other disease of these organs which might grossly alter their structure.

At the meeting of the American Roentgen Ray Society in September, 1931, Einhorn, Stewart, and Illick reported eight cases in which they had given thorium dioxide sol. Because they reported two rather severe reactions several hours following injection, they felt that a medium which is retained within the tissues may be a source of future damage.

References to the work of Radt and Oka are to be found in recent foreign literature, indicating that it is arousing considerable interest.

In order that we may attempt to judge the value of this test, appraise its possibilities, anticipate possible dangers, and intelligently use it, it is necessary that we have some knowledge of the chemical and physiologic properties of the substance used in making it, and of the anatomy, physiology, and pathology of the reticulo-endothelial cells.

It is not within the scope of this paper to discuss in detail the reticulo-endothelial system. We shall merely outline the known structure, function, and abnormalities of the cells which make up what may be considered an organ of the body—an organ as diffusely scattered throughout the body as the lymphoid tissue.

Aschoff distinguishes two groups of cells in this system, one stationary and the other free. The stationary group includes the reticulum cells of the splenic pulp, lymphatic tissue, and bone marrow, adrenal cortex, hypophysis, sinuses of the lymph nodes, and spleen. The wandering elements include the tissue and blood histocytes and the splenocytes. Especially important parts of the system, and the ones particularly related to our subject, are the so-called endothelial cells which form the incomplete lining of the sinusoids of the liver and spleen. In the liver, the cells, which are known as the Kupffer, or stellate, cells, lie in direct contact with the blood on the one hand and the liver cells on the other. In the spleen, the cells in question are also to be found lining the sinusoids and forming in addition the branched reticulum cells of the splenic pulp.

On the basis of the difference between the reaction to dyes of the endothelium of the splenic sinuses and that of the reticular cells of the pulp, some recent observers conclude that there is no such thing as "reticulo-endothelium," at least in the spleen. But these newer studies do not invalidate the conception of the functional unity of the reticulo-endothelial system. The term "hemolytopoietic," introduced by Krumbhaar, has merit in that it indicates the organs subserving hematopoietic and hemolytic functions, *i.e.*, the bone marrow, spleen, lymph nodes, and liver. However, we know that there exists in lymphoid tissue, liver, bone marrow, connective tissue, and in the blood stream a group of cells having common morphology, perhaps a common or closely related origin, and a common function. For the sake of simplicity it seems that we may speak of these cells collectively under one head and call them the reticulo-endothelial system, even though it may be intimately connected with other systems. The relation to other systems may possibly be analogous to the relation of the nervous system to the gastro-intestinal and urinary systems.

The generally accepted functions of the reticulo-endothelial system may be summarized as follows:

1. *Phagocytosis.*—It is a well known fact that the reticulo-endothelial cells are able to store colloids and other foreign materials within their cytoplasm. This function forms the basis of the work under consideration.

2. *Hemocytopoiesis.*—The origin of the blood cells is still a debatable question. The findings of Sabin and her co-workers, how-

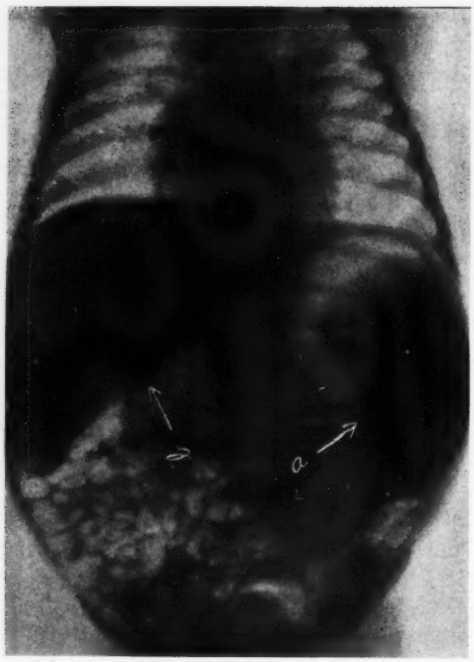


Fig. 1. Shows a definitely enlarged spleen *(a)* and the liver *(b)*, which is probably also enlarged. The patient, who is 18 months of age, has generalized tuberculous lymphadenitis with infiltration in the upper lobe of the left lung.

ever, indicate that the red cells arise from the endothelium of bone marrow, and the white cells—including the polymorphonuclears, the monocytes, and the lymphocytes—come from a primitive reticular cell.

3. *Destruction of Senescent Blood Cells.*—This function is carried on particularly by the cells of the splenic pulp.

4. *Splitting Off of Bile Pigment from Hemoglobin.*—The cells of the splenic pulp remove the iron from the hemoglobin molecule and elaborate an iron-free substance closely allied to bilirubin. This pigment is then discharged into the blood, possibly by disintegration of the pigment-containing cells after they have entered the blood stream. After extirpation of the spleen, these functions are carried on vicariously by other representatives of the reticulo-endothelial system, such as the Kupffer cells of the liver or the reticulum cells of the lymph nodes and bone marrow. It has been shown experimentally that, under normal conditions, approximately 50 per cent of the bile pigment is formed in the cells of the liver and the remainder in the reticulo-endothelial cells elsewhere. The liver, therefore, apparently is no more active in the production of bile pigment, considering its size and weight, than the other cells comprising the system. Rich, by demonstrating the formation of urobilin from hemoglobin in pure cultures of cells of the reticulo-endothelial system, has conclusively proven that the liver is not necessary for the production of bile pigments.

5. *Storage of Iron Pigment.*—The exact function in the storage of iron pigment is not clear. In such conditions as pernicious anemia, the reticulo-endothelial cells are found to be filled with iron-containing pigment.

6. *Apparent Inhibition of the Growth of Tumor Cells.*—The work of Brüda and others indicates that the reticulo-endothelial cells may elaborate a substance which has an inhibiting effect on certain types of tumor cells.

7. *Participation in the Formation of the Characteristic Lesions of Certain Specific Infections.*—It is felt by many investigators that the cells of this system make up the characteristic lesions of tuberculosis, typhoid fever, leprosy, and rheumatic fever. It is thought that they are particularly prominent in the body reactions to kala-azar, trypanosomiasis, typhus fever, Oroya fever, Rocky Mountain spotted fever, trench fever, and measles.

8. *Participation in the Immune Reactions of the Body to Infection.*—This well known function is too broad a subject for discussion in this paper.

Of particular interest to us in our work is the effect on the organism as a whole of

Fig. 2. Shows Riedel lobe of the liver *(a)* and an enlarged spleen *(b)*, due to leukemia. Note the distinctness of the renal shadows *(c)*, which may be due to storage of some of the medium in these organs.

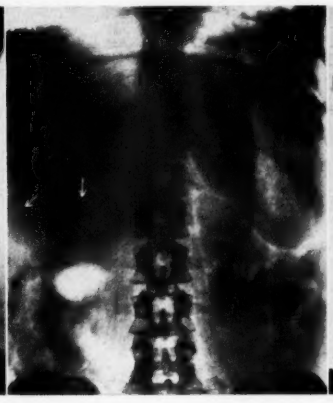

Fig. 3. Shows defect in liver shadow due to hemangioma. Note that it does not have the annular characteristics of carcinoma as shown in Figure 6. It would have been desirable in this case to have placed the film transversely as recommended in the section on technic.

Fig. 4. Shows an enlarged liver —cause undetermined. Note the blood vessel markings in the liver, indicated by arrows.

sudden filling with foreign material of the cells of this system. While the effect of physical blockade of the reticulo-endothelial system has been studied by many investigators, there has been no uniformity in the results obtained. On the one hand, such men as Jungeblut and Berlot, Gay, Clark, and others maintain that the blockade of the reticulo-endothelial system inhibits antibody production. On the other hand, such investigators as Rosenthal, Moses, Petzel, Standeneth, and others hold that there may be even an increased antibody production after blockade of the system.

In this connection the results of experiments by Howell and Beverley should be stressed. These investigators have been able to show that the reticulo-endothelial cells—at least those of the bone marrow, spleen, liver, and lymph nodes—are able to take up foreign material in practically any quantity. This observation was made two years previous to their report by Brickner. Suppression of antibody response to typhoid vaccine could not be accomplished in rabbits and rats after repeated injections of one or of multiple non-protein foreign materials, although these materials were taken up in large quantities by the reticulo-endothelial cells. However, the sudden death of animals which had received injections of non-protein foreign materials, and later typhoid vaccine, indicates that a change occurs in the immediate protective mechanism of the animals. This is also suggested by the intense bone marrow stimulation and pouring out of nucleated red blood cells into the circulation.

Evidence is rapidly accumulating to show that malfunction of the reticulo-endothelial system may result in varied clinical and pathologic manifestations.

There is some evidence to show that the cells of this group represent the cell type in certain leukemias. It is possible that they may form a group of rare tumors, variously termed reticulum cell sarcoma, endothelioma, angioma, etc.

Of particular interest, especially as regards the future of this method, is the work of Rowland, who has made a careful study of the relation between the reticulo-endo-

thelial cells and lipoid metabolism. Some of the conclusions reached by him are as follows:

1. That such diseases as Christian's syndrome, which was first described as a disease characterized by defects in the membranous bones, exophthalmos, and diabetes insipidus; Niemann-Pick's disease, which is a rapidly developing generalized xanthomatosis of infancy, and Gaucher's disease, which is a similar condition with infiltration of more complex lipoproteins, all represent lipoid metabolic diseases of the reticulo-endothelial system in which lipoids are stored in the reticulo-endothelial cells. Each of these conditions differs in clinical form and pathologic structure of the lesions and in the nature of the lipoid concerned, but all are manifestations of the same pathologic process, perhaps modified by certain differences in the patient's general metabolic state.

The bone destruction, exophthalmos, diabetes insipidus, dwarfism, and infantilism, which are often present and are frequently regarded as evidence of disturbed pituitary function, are the results of this pathologic change. The same cause can be assigned for the less often observed dystrophia adiposogenitalis, and for certain confusing blood pictures.

2. That the nodular lesions with their varied pathologic changes (sometimes in a late stage of development not even showing foam cells) are hyperplastic new formations. This gives support to the opinion that a considerable number of yellow to yellowish-brown, lipoid-containing, so-called endotheliomas, angiomas, giant-cell fibrosarcomas of the dura, periosteum, pleura, and peritoneum are not autogenous growths but are lipoid storage tumors.

3. That recognition of the fact that the varied symptomatology is caused by pathologic changes resulting from hyperlipoidemia is important, since in this manner the pathogenesis of a number of other obscure conditions can be explained.

4. Finally, Rowland concludes that, when viewed in all its many forms, this lipoid metabolic disease of the reticulo-endothelial system, which may be termed "lipoid gout," is by no means a rare condition.

Thorium is a very heavy metal which closely resembles radium in its chemical and physical properties. Like radium, it gives off three forms of radiation and an emanation differing chiefly in the rate of disintegration and, consequently, in the duration of the stages. While thorium gives off only the alpha rays, it breaks down very slowly into mesothorium, which gives off alpha, beta, and gamma rays. For this reason a specimen of thorium may continue to increase in activity for several years. Mesothorium changes in a day or so to emanation which lasts only a few minutes, whereas the emanation of radium lasts several days. The last stage of thorium, like that of radium, is probably lead. The chief effect of large doses is a change in the blood or blood vessels leading to multiple hemorrhages which may prove fatal. In man, death has resulted from the ingestion of an amount of thorium equivalent to 100 $\mu$g. of radium.

A peculiar, severe, and often fatal chronic intoxication is seen in persons who use luminous paint containing about 20 per cent of radium and 80 per cent of mesothorium. Because the brushes used are frequently moistened with the lips it is estimated that as much as 27 gr. might be swallowed daily, containing up to 40 $\mu$g. of radio-active substance. After a year or more, necrosis of the jaw and necrotic changes in the throat develop, associated with anemia of the pernicious type, which may prove fatal without further intake of the poison (Hoffman, Martland). Autopsy shows radio-activity of many tissues, most marked in the bones, and scattered petechial hemorrhages in the abdominal viscera.

Moderate doses, especially if injected,

Fig. 5. Shows small liver *(a)* and a greatly enlarged spleen *(b)*. The patient has had syphilis. The cause for the splenomegaly and small liver has not been determined.

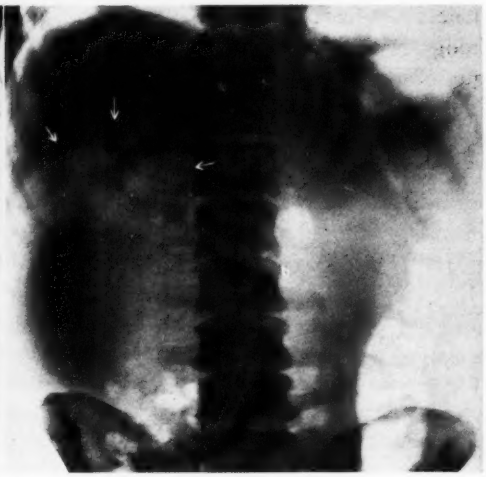

Fig. 6. Shows enlarged liver. Note the more or less conglomerate annular defects in the liver shadow due to carcinomatous nodules. Annular defects, with increased density at the periphery, seem to be characteristic of carcinoma.

bring about striking changes in the circulating blood. The leukocytes are destroyed and in a day may fall to as low as 10 per cubic millimeter (Rosenow, Farber). The effect is chiefly exerted on the polymorphonuclears. There is delay in clotting time, and hyperemia, followed by degeneration of the blood-forming organs.

Certain products of thorium have been used in medicine for some time. Thorium nitrate and sulphate, which have astringent properties, have been used in the treatment of diarrhea. Weak solutions of thorium sulphate have been used in typhoid fever with reported good results. Thorium sodium citrate has been used for diagnostic purposes in pyelography and cystography. Thorium dioxide has been used in suspension as a medium in gastro-intestinal examinations. It is a heavy white powder, insoluble in water and dilute acids.

The contrast medium used in our work is a stabilized thorium dioxide sol, recently perfected by Kadrnka, and sold under the trade name of "Thorotrast." It contains 25 per cent of thorium dioxide sol (22 per cent of thorium dioxide metal). In order to test the preparation for possible radioactivity, photographic films were exposed to it for 12 hours, but showed no effect. Samples were tested by the United States Bureau of Standards with negative results.

It is diluted in the proportion of 1 to 10, with 5 per cent glucose solution. It is opalescent, odorless, and has the consistency of heavy oil. A homogeneous solution can be produced by dilution with normal saline up to 1 to 8. It may also be used for cystography and pyelography.

In hepatosplenography, from 15 to 25 c.c. daily on three consecutive days is administered intravenously, the dosage depending upon the estimated size of the liver and spleen. In general, the density of the roentgen shadows of the liver and spleen will depend upon the quantity of the opaque medium administered and the anatomic and functional integrity of the cells that store it. If only the outlines of the liver and spleen are desired, the dose may be reduced one-half.

According to Kadrnka, the initial dose

should not exceed 0.1 gm. or 0.05 gm. per kilogram until on the average a total of 0.3 gm. of thorotrast has been administered per kilogram of body weight. Films may be made at any time after four hours following the last injection. On the night before the examination, the patient is given the usual evening meal and at bedtime 8 gms. of compound licorice powder. On the morning of the examination, a cleansing enema is given and the patient is advised to come to the roentgen department without breakfast. Films are taken on the Potter-Bucky diaphragm with the patient in both the prone and supine positions. The tube is centered over the ensiform cartilage. The following technic has been used by us in patients of average physique: 60 K.V.P. at 100 ma. for 3.5 seconds at 25 inch distance. In large individuals, in order to get good images of the spleen and liver on the same film, it is well to place the film transversely. The liver should cast a shadow of approximately the same density as the spine. The spleen normally should be slightly less dense.

In our clinic, 16 patients were subjected to this test. Three of these were children, one was 18 months of age, one six years, and one 11 years. The ages in the other patients varied from 35 to 55 years. Immediate or remote ill effects were not noted except in one case. A child six years of age, who had had a clinical diagnosis of tuberculous lymphadenitis, showed slight swelling about the eyes and mouth a few hours following the injection of 15 c.c. of thorotrast. Two patients died during the course of the examination. Both of these patients were in a semiconscious state before the administration of the medium and it is, therefore, felt that the test was in no way responsible for death. At autopsy, one of these patients showed cirrhosis of the liver and the other carcinoma of the head of the pancreas.

We were able in all cases to obtain a clear image of the liver and, in most cases, of the spleen. Occasionally, if the spleen was small, its shadow could not be differentiated from that of the left lobe of the liver. The liver shadow was found to be of the same density as the spine, and the spleen of about the same density as that of the ribs. In one of our cases, a child 18 months of age, the liver and spleen were of approximately the same density as a barium-filled stomach. In the liver, clearly defined branching blood vessels were noted in several instances. Vessels which lie parallel with the rays appear as small, round or globular negative shadows. Structural changes in the spleen, as described by Radt, could not be demonstrated in our cases.

For the sake of simplicity we shall divide our cases into several groups, according to the various problems encountered.

The first group comprised four cases. In each case, a mass was palpable in the left upper quadrant of the abdomen. The question arose as to the nature of the mass, that is, whether it was splenomegaly or tumor. In all cases it was possible by this method to make a positive diagnosis of enlargement of the spleen. Furthermore, it was possible under fluoroscopic observation to visualize simultaneously the splenic shadow and to palpate the spleen.

In the second group of cases, we were confronted with the problem of confirming or disproving a clinical diagnosis of metastatic carcinoma of the liver. In two cases out of six examined, we were able to make a positive diagnosis of metastases. One of these was verified at autopsy. In the other the roentgen findings were so definite that there was little room for doubt. Of the remaining four cases, one showed an enlargement of the liver, but there was no autopsy. Another showed questionable metastases which have not as yet been verified or disproved. In another case, the films were not suggestive of metastases and an extensive tuberculous peritonitis was revealed at oper-

ation without evidence of involvement of the liver. In a fourth case, metastases were found neither in the radiographic examination nor at autopsy.

Carcinomatous nodules appear as areas of lessened density surrounded by a halo of greater density. The less dense areas can be explained by the fact that the cells in the carcinomatous nodules are unable to take up the medium. The increased density peripherally may be the result either of increased phagocytosis of the medium by these cells, or of a concentration of the cells about the nodules, as the result of pressure from rapid growth of cancer cells.

A third group consisted of two cases of leukemia associated with splenomegaly. The observations on these cases are still incomplete. We hope, however, to correlate the blood findings with the size of the spleen. The fact that the medium is in the liver and spleen for an indefinite time allows visualization of these organs at frequent intervals. In one of these two cases, a shadow, having the appearance of a Riedel's lobe, was noted.

In two cases of obstruction of the common bile duct, marked enlargement of the liver was found, but no alteration in liver structure could be discerned.

In the last group of cases, examinations were done in an attempt to show changes which were previously disclosed at operation. In one case, metastatic nodules in the liver were clearly demonstrated. In another case, a large hemangioma, which had been found one year previously at operation, was clearly defined. The absence of a dense halo about this tumor mass led us to believe that it was a benign tumor. There was merely an irregularly defined defect along the lower border of the liver.

An attempt was made to show changes in other organs containing reticulo-endothelial cells, *e.g.*, lymph nodes, bone marrow, hypophysis, etc. The concentration of the medium in these organs, however, was not sufficiently great to show any alteration in structure.

In conclusion, our experience indicates that the use of this method offers possibilities of diagnosis hitherto unattained. Experience is as yet too limited to enable one to establish criteria of interpretation or to determine the possibility of remote harmful effects. We believe, however, both from theoretic considerations and practical experience, that it is probably as safe as other intravenous injections which are used routinely for diagnosis and therapy and that it opens up a new field for investigation which may have far-reaching results.

*Note.*—We desire to express our indebtedness to the staffs of Georgetown University Hospital, Children's Hospital, Gallinger Hospital, Garfield Memorial Hospital, Emergency Hospital, and Providence Hospital for co-operation in this study.

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DISCUSSION

DR. LEO GEORGE RIGLER (Minneapolis, Minn.): I have been much interested in this beautiful and comprehensive presentation of the subject, because we have had a limited experience along the lines that Dr. Otell described.

I might say that in the very small number of patients on whom we have used it, we have had no reactions that have been at all alarming. My assistant, Dr. Erickson, and our hematologist, Dr. Fallon, have been particularly interested in some cases of a rather rare blood disease called "reticulo-endotheliosis," in which the reticulo-endothelial system overacts in much the same way that we find the blood-forming organs over-acting in leukemia.

With the extension of these abnormal cells into the blood stream, we hoped, by the use of this material in one such case, to be able to demonstrate the change in function of the reticulo-endothelial system. Unfortunately, the patient was almost moribund at the time we were able to get him into the hospital for study.

We did find a striking result after a very small dosage. The leukocyte count, which had been around 3,000 or 4,000 (containing large numbers of abnormal cells), dropped to 500 after this dosage, although the patient felt much better and, for a short period, the abnormal cells stopped appearing in the blood stream.

We were struck by the fact that we did not get, in this particular case, as good shadows of the liver and spleen as we did in the normal individuals on whom we tried it. I think myself that there is a large field open for investigation.

We have done a certain amount of animal experimentation. In the rabbit one gets the most brilliant films of the spleen with delineation of the individual follicles. These can easily be studied.

In the Department of Physiology, at the University of Minnesota, a great deal of work has been carried out with a view to visualizing the functions of the spleen, as has been done in many other institutions. We are particularly interested in changes in the size of the spleen under various conditions, such as after eating a meal and changes in blood volume. In the past they have been compelled to study these, of course, either by the use of measurements on the outside of the body—which is a relatively unsatisfactory method—or by making a window in the abdomen and observing the spleen through it—which is also relatively unsatisfactory.

We have just begun some work, which, from the experimental standpoint, we feel is going to be a remarkable advance in the ability to study the functions of the liver and spleen because of our ability to observe the changes in form and size under various conditions.

DR. EUGENE FREEDMAN (Cleveland, Ohio): I think there is a great field for the application of this method, not only in the diagnosis of different lesions in the reticulo-endothelial system, but also in making a differential diagnosis between certain lesions of the right upper quadrant, as, for instance, between liver abscess and subphrenic abscess, or between a subdiaphragmatic tumor and an encapsulated epidiaphragmatic pleural effusion.

Not long ago a patient was admitted to the Cleveland City Hospital in an acute abdominal condition—high temperature, leukocytosis, spasticity of the abdominal muscles, and tenderness over McBurney's point. Clinically, a dull area was found at the right base. The question of differentiation between a subphrenic abscess and acute appendicitis came up.

The patient was fluoroscoped, whereupon the right diaphragm was found to be immobile, with a sharply defined, semicircular, bulging area at its dome. The roentgenologic diagnosis of subphrenic abscess was made, but, on tapping the subphrenic area at different places, no pus could be obtained. On account of this negative finding, the incision at the subsequent operation was made over McBurney's point and a badly inflamed distended appendix was found on the verge of rupture, and re-

moved. The patient made an uneventful recovery, but a subsequent re-examination still showed the semicircular shadow and immobile right diaphragm.

We were unable to make a definite diagnosis in this case, but considered two possibilities: A benign tumor of the liver (lipoma?) or a partial herniation of the liver through the diaphragm. In this case, the roentgenologic findings were certainly misleading.

I think, in similar conditions, this method will prove to be a great additional aid, if only it can be perfected to obtain good visualization of the liver and spleen in a shorter time.

DR. GROOVER (closing): Of course, we realize, in presenting this paper, that we are in no position to draw definite conclusions of the value of this test.

Before we began using it, the reticulo-endothelial system, to me, was little more than a name, and I am sure that is the case with many. The test at once impressed us with the great importance of these cells. Whether or not it turns out to be of practical value as a diagnostic procedure, it will stimulate interest in investigating the physiologic and pathologic properties of the reticulo-endothelial system.

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*"Atmosphere" of Atoms Known; Nucleus Still Unexplored.*—Knowledge of the atom has increased immensely during the past few years; yet all the information scientists have gained is about the outer shell of electrons—the "atmosphere" of the atom. The nucleus, the inner core of the atom, where most of its mass is concentrated, is still a nearly unknown thing. This was the theme of an address on "The Assault on Atoms," delivered before the meeting of the American Philosophical Society by Prof. Arthur H. Compton, of the University of Chicago.

After reviewing the steps by which physicists have invaded the atom's atmosphere of electrons, Prof. Compton said that of all the scientific pictures of this part of the atom, the only adequate one is that proposed by the brilliant young German, Dr. W. Heisenberg, "according to which electrons move about more or less at random in the region of this atmosphere."

"Does this mean that the problem of the structure of the atom is solved?" Prof. Compton asked, and then answered: "Not yet. We feel that we know in general outline what this electron atmosphere is like; but there is the atomic nucleus. What is it?

"It is the nucleus of the atom from which the alpha particle comes. The release of each such particle liberates a million times the energy released at the explosion of a molecule of T. N. T. Studies of these alpha rays indicate that around the nucleus of the atom exists an electrical wall which prevents outside alpha particles from entering and inside particles from leaving. The study of spectroscopy and radio-activity has given some information. Yet the nucleus of the atom, with its precious hoard of energy, presents a fascinating mystery. In this direction, probably, will turn the physics research of the next generation."—*Science Service.*

# PROGRESS IN RADIOLOGY
## —1931—

THIS is the first of a series of reports concerning progress in the various fields of radiology during the preceding year. The object of these reports will be to present, with the reviewer's comment, an abstract of the significant literature pertaining to the subject. Reports of a similar nature pertaining to other branches of medicine have appeared in various journals for several years, and have been of great value, particularly to physicians who do not have access to a large medical library. The increasing importance of radiology in all fields of medicine, and its natural division into several specialized branches, has made it increasingly difficult for the general radiologist to keep informed of the significant literature of his specialty. Such a situation has suggested this report, which we hope will render a definite service to the profession.

The various reports have been compiled by radiologists whose work in their particular fields is well known. They have cooperated wholeheartedly and given freely of their time, in order that this report may fulfill its intended purpose.

JOHN D. CAMP, M.D.

## PROGRESS IN RADIOLOGY DURING 1931: THE THORAX

By W. WALTER WASSON, M.D., DENVER

### PART I, INCLUDING TUBERCULOSIS

RADIOLOGY has come to be such an integral part of the therapeutic and diagnostic armamentarium that there is scarcely a case reported or an article published in which one of its various phases is not used. The radiologic literature concerning the thorax, for the year 1931, has been voluminous. From more than six hundred articles examined, the 480 mentioned in the subsequent discussion represent only a portion of the material written during the past eighteen months, and they have been chosen to indicate experimental and observational advances. Dr. Rufus Cole[1] has said that "no period in history can be satisfactorily isolated from that which precedes and follows." This is especially true in reviewing the progress of a scientific subject as recorded in the publications. It is difficult to set arbitrary time limits; and this survey, supposedly of the progress in radiology for the year 1931, must necessarily overlap a bit onto the end of 1930 and the beginning of 1932. An attempt has been made to classify the material according to the major subject interest.

There are two items of interest to all radiologists. The first of these is the erection of another monument to Professor Roentgen.[2] The monument, which was unveiled on November 30, 1931, is in Remscheid-Lennep, the birthplace of the scientist, and is the third to be erected in his honor. The second item is the Third International Congress of Radiology[3] which was held in Paris in the Summer of 1931. Dr. Béclère, the president, presided; and there were 1200 delegates, although none of the German radiologists were able to attend because of the financial conditions.

*General.*—There are two publications of general interest in regard to the thorax. The first is Rigler's[4] Outline of Diagnosis, and

[1]The Harvey Lectures, Series XXV, The Williams and Wilkins Co., Baltimore, 1931, page 182.

[2]Jour. Am. Med. Assn., Jan. 10, 1931, XCVI, 128.

[3]Ibid, Sept. 12, 1931, XCVII, 790.

[4]Journal-Lancet, July 1, Aug. 1, Sept. 1, 1931, LI, 417, 478, 547.

the second is the excellent compendium on the action of the roentgen rays and radium on the heart and lungs by Desjardins.[5] Both of these publications appear in serial form.

That there are many clinicians who must still be convinced of the value of the roentgen diagnosis of chest conditions, is evidenced by an editorial in the *Canadian Medical Association Journal*.[6] In it, the editor is constrained to consider both sides of the question, and he concludes, of course, that we are constantly growing more dependent on the X-ray, as the title says.

*Books.*—Among the noteworthy books are several, each of which is deserving of considerable comment. Because of the necessity for brevity, all that may be done here is mention these volumes and suggest direct perusal of them. They are:

Stoloff, E. G.[7]: The Chest in Children Roentgenologically Considered;

Brauening, H., and Redeker, F.[8]: Studies on the Development of Human Pulmonary Tuberculosis, II—Tuberculous Developments from the Group of Early Infiltrates and the Tuberculous Reinfiltrations;

Sergent, É., Bordet, F., Durand, H., and Couvreux, J.[9]: Radiologic Exploration of the Respiratory Apparatus;

Schinz, H. R., Baensch, W., and Friedl, E.[10]: Textbook of Roentgen Diagnosis;

Dünner, L., Leeser, F., and Blume, H.[11]: Pulmonary Syphilis in Adults;

Bernard, L.[12]: The Beginnings and Arrest of Pulmonary Tuberculosis;

Birk, W., and Schall, L.[13]: The Treatment of Children's Diseases with Ultra-violet and Roentgen Rays.

[5]Am. Jour. Roentgenol. and Rad. Ther., January, February, March, 1932, XXVII, 153, 305, 479.
[6]Canadian Med. Assn. Jour., October, 1930, XXIII, 563.
[7]Paul B. Hoeber, New York, 1930.
[8]Johann Ambrosius Barth, Leipzig, 1931.
[9]Masson et Cie, Paris, 1931.
[10]Georg Thieme, Leipzig, 1932.
[11]Johann Ambrosius Barth, Leipzig, 1931.
[12]Masson et Cie, Paris, 1931.
[13]Urban and Schwarzenberg, Berlin, 1932.

ATELECTASIS AND COLLAPSE

The range of material on the two allied conditions, atelectasis and collapse, extends from spontaneous acute massive collapse through experimental and clinical observations following operative procedures and chronic conditions to theories concerning the etiology of the conditions.

*Theoretical.*—Two separate groups of investigators have presented theories on the etiology of atelectasis; both are plausible, but they conflict with one another. From animal experimentation and clinical observations, Van Allen and Lindskog[14, 15, 16] observed that although plugging of a main trunk bronchus produces complete atelectasis of the lobe supplied by that bronchus, plugging of a smaller branch will not produce complete collapse. They predicate that this latter effect is due to exchange of air and gases between the alveoli at the periphery, which they term "collateral respiration." Coryllos and Birnbaum[17] also report careful experimental observations carried out on dogs with the help of ingenious apparatus and a method for direct vision of the pulmonary changes occurring during the experiment. Their evidence would seem to indicate that "the mechanics of atelectasis are based on the physiology of the exchange of gases in the lung," and that "nitrogen in the respired air plays the part of a mechanical 'buffer,' retarding the absorption of more diffusible and more soluble gases." They adhere to the theory of occlusion as etiologic for atelectasis (that is, atelectasis results from occlusion of a lobar or common bronchus), but they feel that patchy atelectasis results from an inflammatory condition of the alveolar tissue and plugging. In other words, the etiology of atelectasis is controlled by the physical and chemical factors

[14]Arch. Surg., December, 1930, XXI, 1195.
[15]Surg., Gynec. and Obst., July, 1931, LIII, 16.
[16]Jour. Orient. Med., November, 1931, XV, 83.
[17]Arch. Surg., December, 1930, XXI, 1214.

of gas absorption and the physiologic integrity of the alveolar membrane.

*Observational.*—Korol[18, 19, 20] has approached his studies from the clinical angle, and he bases his conclusions on observation of patients. He finds that massive atelectasis can occur without the occlusion of large bronchi. He feels that poor ventilation and the inactivity of the diaphragm are often the cause of atelectasis in patients who undergo prolonged recumbency. He finds it a common occurrence in tuberculosis, responsible for such important signs as contraction of the chest and lung, limited mobility, feeble or absent vesicular murmur, and a decreased complemental space. He also finds that when it is due to the compression of a bronchus it is a frequent accompaniment of certain intrathoracic conditions. Allen's[21] observations on 94 surgical cases subjected to pre-operative and post-operative chest X-ray examinations show a unilateral high position of one hemidiaphragm in 43 per cent, and a bilateral high position of the domes in 57 per cent. He feels that the high position of one dome of the diaphragm may give the erroneous impression that atelectasis is present. He reports his findings because of the value in the diagnosis of post-operative chest films. Hennell[22] finds that "in the so-called 'advanced unilateral fibroid phthisis' massive atelectasis of large portions of pulmonary tissue, occasionally involving most of one lung, is probably the essential mechanism of the evolution of the clinical and pathologic condition." Brown[23] feels that the term "partial atelectasis" is incorrect because "atelectasis is complete in any given area but is limited to a greater or lesser portion of the lung according to the magnitude or number of the bronchi that are obstructed," and he advises use of the terms of Lee and Tucker, with the addition of one of his own, for classification: (1) massive; (2) lobar; (3) lobular, and (4) scattered lobular (Brown). He has gained the impression from animal experiments and clinical observations that spinal anesthesia predisposes to post-operative pulmonary atelectasis.

*Post-operative.*—Brunn and Brill,[24] in a second report of their observations on every patient operated upon in the Clinic on Thoracic Surgery at the University of California Medical School, find atelectasis to be the predominating post-operative pulmonary complication. They find that the most important single factor in its production is bronchial obstruction. In one unusual case, they found localized bronchial edema.

*Collapse.*—Potter[25] defines collapse from several causes, but discusses only massive collapse due to tumor of a bronchus and collapse in pneumothorax. He reports two cases of the former and one of the latter, and concludes that because of the similarity of collapse and pneumonia there should be an X-ray examination of all surgical cases with pulmonary complications. He advises using postural treatment early in an effort to reinflate a collapsed lung, often without impairment of function. Jacobaeus and Westermark[26] have continued their studies on massive collapse, and they report four cases among 25 of hemoptysis. There were several acute cases with bronchitis and three with bronchiectasis, five with chronic pulmonary tuberculosis without hemoptysis, and five of lung tumors with partial lobar collapse. They feel the collapse had a bad effect in their cases of chronic pulmonary tuberculosis.

*Carbon Dioxide.*—It is the belief of Henderson[27] that general use of carbon dioxide and oxygen in resuscitation and as a prophylactic measure immediately after birth,

[18] Am. Rev. Tuberc., September, 1931, XXIV, 276.
[19] Ibid, May, 1931, XXIII, 493.
[20] U. S. Vet. Bur. Med. Bull., January, 1931, VII, 10.
[21] Radiology, April, 1931, XVI, 492.
[22] Am. Rev. Tuberc., May, 1931, XXIII, 461.
[23] Arch. Surg., June, 1931, XXII, 976.
[24] Ann. Surg., November, 1930, XCII, 801.
[25] Radiology, August, 1931, XVII, 271.
[26] Acta Radiologica, 1930, XI, 547.
[27] Jour. Am. Med. Assn., Feb. 14, 1931, XCVI, 495.

would materially reduce neonatal partial atelectasis, secondary asphyxia, pneumonia, and mortality. He feels that a simple inhalator for administering these gases is a necessary part of the equipment of every maternity hospital, and that similar apparatus should be accessible for rental in home deliveries.

### BRONCHIECTASIS

In a second publication by Lloyd,[28] he refers to his former article on pulmonary atelectasis and the process by which an atelectatic area becomes fibrotic and there is consequent permanent loss in lung volume. In the latter article, he adds the other successive stages which he theorizes are the ones in the development of bronchiectasis. Boyd's[29] excellent survey of 56 cases of bronchiectasis in children brings out the point that although injection with an opaque medium is the ideal diagnostic procedure, there are times when such injection is impossible. Therefore, she thinks it is wise to know the usual X-ray signs. She prefers stereoscopic roentgenograms, but says the flat plate is also valuable. She notes certain suggestive evidence that aids in the diagnosis of early cases: (1) extensive fibrosis; (2) cardiac displacement; (3) blurring of the cardiohepatic angle; (4) enlargement of the hilus glands with no other evidence suggestive of tuberculosis. In well established cases, she mentions the characteristic "honeycombing," particularly in the lower lobes, as pathognomonic.

### PNEUMOTHORAX

Palmer and Taft[30] define pneumothorax as the presence of air in the pleural cavity from any internal cause. They state that there are two types, idiopathic and that associated with pathology, and report five cases of spontaneous pneumothorax. The remainder of the publications on the subject consists of cases reported because of rare complications, therapeutic procedure, etiology, or confusion in diagnosis.

[28]New England Jour. Med., Dec. 10, 1931, CCV, 1143.
[29]Canadian Med. Assn. Jour., August, 1931, XXV, 174.
[30]Jour. Am. Med. Assn., Feb. 28, 1931, XCVI, 653.

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## CIRCULATORY SYSTEM

*Mensuration.*—Theoretically, the ideal method of instruction in any subject entails first a study of the normal, and then the deviations from that normal. Fray[31, 32] observed about seventy-five persons ranging in age from 8 to 72 years, and with heart conditions from the normal to the ultimate in pathology, death. The material was carefully evaluated, and his technic painstakingly established. His results embody the conclusion that the left postero-anterior oblique position offers the best opportunities for mensuration of heart size and enlargement. He is able to define the normal cardiothoracic index and that of the enlarged heart, and to determine the type of enlargement (right or left). Further work is in preparation for publication.

*Experimental.*—In the field of experimental research, the work of Businco and Cardia[33] in the production of pulmonary embolisms and the study of their distribution, offers interesting data. They used dogs, and their procedure entailed the injection of bismuth in oil into the jugular or femoral veins at regular intervals of from fifteen to twenty seconds until the animal was asphyxiated, which occurred in from five to fifteen minutes. They found that when the fluid was peripherally injected, it proceeded to the heart and was found in the lungs within from twenty to thirty seconds. It was usually seen chiefly in the basal portion of first one lobe and then in the same area of the other lobe, the right lower lobe being the most common site of first appearance. They conclude that gravitation evidently has an effect, that the origin and location of the original embolic process is probably of importance for the localization in the lung, and that the direction, length, width, and distribution of the right pulmonary artery are partly responsible for the predominant localization of embolisms in the right lower lobe.

Werthemann[34] studied the changes in the

[31] Am. Jour. Roentgenol. and Rad. Ther., February, 1932, XXVII, 177.
[32] Ibid, March, 1932, XXVII, 363.
[33] Fortschr. a. d. Geb. d. Röntgenstrahlen, July, 1931, XLIV, 60.
[34] Strahlentherapie, Nov. 29, 1930, XXXVIII, 702.

myocardium of rabbits following roentgen irradiation. He treated two series of animals; the only difference was the size of the area irradiated. Treatment was continued until death ensued, when histologic examinations of the hearts showed parenchymal changes consisting of degeneration and atrophy, with marked decrease of nuclei. There were also changes in the interstitial connective tissue consisting of extensive inflammatory infiltration with sclerosis. Zwaardemaker and Feenstra[35] report resuscitation of the heart of an eel or frog after it had stopped beating on account of removal of its permeable potassium salts. They irradiated the heart by means of a Grenz-ray tube (5 mm. distance, 4 ma.-hr.) and it started to beat again 28 minutes after and continued to beat for six hours. They believe this is the first series of experiments to show the electromagnetic roentgen rays have a similar effect upon the heart to the one from the corpuscular, alpha, and beta rays, as has been shown previously.

*Uroselectan.*—Salotti's[36] preliminary report on some of his studies with uroselectan is on the circulation in the lungs and hilum, and on the radiologic appearance of the superior vena cava. His findings are interesting, but he believes they will be of greater importance clinically when the technic is improved.

*Azygos Vein.*—Crosetti[37] reports five cases of azygos vein which he observed at his clinic for the study of tuberculosis, using teleradiography with an exposure of one-tenth second. He points out that both statistics and interpretation of radiographs are somewhat contradictory, and believes that the difficulty encountered in the interpretation of a film is due either to the lightness of the opaque band of the meso-azygos or to its unusual location, and that it is easy to mistake the image of the vein for shadows of old sclerotic lesions or calcified nuclei. The anomaly may cause an hypophonia of different intensities in the corresponding apical field. This sign should be a further aid to the semeiotic control, but it must be confirmed by appropriate radiologic examination.

*Pulsation.*—Gas in the pleura, even in small amounts, causes the heart pulsation to take on the appearance of an oscillating or spring contraction, and increases the speed of the heart excursion. Vallebona's[38, 39] description of spring pulsation is illustrated with roentgenograms of cases which support his theory that the condition is due to withdrawal of the lung pressure from the heart.

*Coarctation of the Aorta.*—The roentgen diagnosis of coarctation of the aorta is possible and practicable. This fact is emphasized by an editorial[40] in which the diagnostic signs are reiterated. These are: (1) a defect in the continuity of the arch, and (2) erosion of the ribs posteriorly. To detect the defect, both roentgenoscopic and roentgenographic examinations are necessary, and also postero-anterior left oblique roentgenograms. Ernstene and Robins[41] report a case that showed extensive erosions of the inferior borders of the ribs bilaterally, an excellent reminder of the efficacy of the roentgen examination.

*Syphilis.* — Electrocardiographic records of 27 adult cases of early syphilis studied by Ingraham and Maynard,[42] at the Cardiac Clinic of the Brooklyn Hospital, showed that the tracings fell within normal limits. Of 23 of these patients studied by teleroentgenograms, six showed slight widening of the aorta, but not beyond the limits of normal deviation. The study by Kurtz and Eyster[43] of 54 cases of acquired syphilis and 12 of the congenital type seems to indicate that

[35]Strahlentherapie, 1930, XXVI, 368.
[36]Arch. di radiol., May-June, 1931, VII, 633.
[37]Minerva med., April 21, 1931, XXII, 606.
[38,39]Arch. di radiol., 1930, VI, 827.
[40]Am. Jour. Roentgenol. and Rad. Ther., March 1931, XXV, 385.
[41]Ibid. February, 1931; XXV, 243.
[42]Am. Heart Jour., October, 1930, VI, 82.
[43]Ibid, October, 1930, VI, 67.

fluoroscopic examination is more reliable as a diagnostic procedure. In the acquired form, they found evidence of aortitis in 90.7 per cent, aneurysm of the aorta in 18.5 per cent, and cardiac enlargement in 38.9 per cent. In the congenital form there was evidence of aortitis in 36.4 per cent, and aneurysm of the aorta was absent in all. In an additional group of 23 cases of acquired syphilis, in whom central nervous system disease was exhibited primarily, aortic involvement was evidenced in 95.7 per cent, and aneurysm could be demonstrated in 21.8 per cent. Hampton, Bland, and Sprague[44] describe the method of study of the aorta which is in use now at the Massachusetts General Hospital, and which they believe is valuable even in cases in which the clinical impression is unknown to the roentgenologist. From measurements made with their technic, they feel justified in deducing the normal and arteriosclerotic aorta with dilatation. From his review of 40 proved cases, Steel[45] thinks that syphilitic aortitis can be suspected when a diffuse dilatation is present and is associated with a normal-sized heart silhouette; or when a dense high aorta is present in a young individual without previous hypertension, he believes the condition may be safely diagnosed when localized dilatation associated with localized increased pulsation is demonstrated.

*Radiotherapy.*—Freund[46] has used radiotherapy in diseases of the heart since 1906 when he treated a case of insufficiency and stenosis of the mitral valve with good results. Since that time he has also had good results from treatment with the mercury vapor light and ultra-violet irradiation in cases with angina pectoris and disturbances of compensation. He says that in his case of organic heart disease the result was not conclusive, but that others report good results in similar conditions.

*Case Reports.*—Among the case reports of rarities are: one of hydropneumopericardium which evinced the characteristic splashing sound;[47] eight cases of pericarditis with effusion;[48] one of aneurysm of the pulmonary artery;[49] three cases of passive congestion of the lungs in the presence of coronary sclerosis,[50] and one case of persistence of the right-sided aortic arch which was demonstrated by careful roentgen examination.[51]

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[44]Am. Heart Jour., October, 1930, VI, 77.
[45]Ibid, October, 1930, VI, 59.
[46]Strahlentherapie, 1930, XXXVI, 516.
[47]Jour. Am. Med. Assn., Jan. 17, 1931, XCVI, 187.
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### FUNGUS DISEASE

The literature on fungus disease of the lung is constantly increasing. Although the diagnostic signs for the roentgenologist are often reiterated, the consensus of opinion is that the final positive diagnosis is dependent upon the laboratory findings. Most of the material on this condition appears as case reports. Good[52] adds 13 more cases to the number already recorded as actinomycosis. His youngest patient was two and one-half years old. Stöve[53] found the roentgen examination negative in his patient, a boy of fourteen years, who was sent to the clinic with a diagnosis of chronic pulmonary tuberculosis with perforated pleural empyema. He made his diagnosis from the sputum examination and the tuberculin reaction. Siebert[54] reports another case of actinomycosis in which the strong fetid odor was an especially characteristic symptom. The clinical course and the roentgenogram were deceiving. Forman's[55] case was diagnosed from the admission roentgenogram. After iodide and vaccine therapy, the final X-ray examination showed an essentially negative chest, and recovery was assumed. On the other hand, Lüdin[56] reports that potassium iodide was not effective in the treatment of his case of actinomycosis, with involvement of the left lower lung and fistula formation. He used roentgenotherapy (four fields over the diseased part of the lungs; each received 200 r, 160 K. V., 8 mm. Al, 25 cm. F.S.D., $10 \times 10$ sq. cm. field), and after the first series, there was closure of the fistula, temporary disappearance of pain, and improvement of the general condition. Following the second series, there was a clinical cure. He suggests the use of the same dosage in similar cases. Kirklin and Hefke[57] report 14 cases of thoracic actinomycosis observed at the Mayo Clinic. They describe the roentgen changes in detail, and state that pulmonary and pleural lesions associated with areas of destruction in portions of the ribs or sternum, with or without osteomyelitis and periostitis, constitutes a combination which is the sole roentgen syndrome that is more or less diagnostic, or at least strongly indicative. They believe that careful roentgen examination of the thorax, in all known cases of actinomycosis, would probably lead to earlier discovery of thoracic involvement and to better therapeutic results.

During the routine examination of 18,825 persons, Sayers and Meriwether[58] found about 125 cases of typical miliary lung disease as revealed by the X-ray examination. Of 88 of these persons whose sputum was

[52]Arch. Surg., November, 1930, XXI, 786.
[53]Arch. f. Kinderh., Oct. 21, 1930, XCI, 241.
[54]Deutsche med. Wchnschr., May 29, 1931, LVII, 936.
[55]Jour. Med. Assn., South Africa, Aug. 22, 1931, V, 515.
[56]Strahlentherapie, Oct. 24, 1931, XLII, 466.
[57]Am. Jour. Surg., July, 1931, XIII, 1.
[58]Pub. Health Rep., Dec. 5, 1930, XLV, 2994.

examined, tubercle bacilli were present in two. In 31 cases in which unstained smears were made, fungi of two types were identified—*Aspergillus fumigatous fisheri* and *Aspergillus niger*. The report of five cases of yeast infection of the lungs by Healy and Morrison[59] stresses again the necessity for careful laboratory examinations because of the similarity to pulmonary tuberculosis in both clinical and roentgenologic pictures. Barbero[60] felt that mycosis was a common complication of pulmonary tuberculosis, and his cultures from 54 patients with pulmonary tuberculosis confirmed his contention.

PNEUMOCONIOSIS

Because of their commercial importance, the pneumoconioses have been the cause of considerable study. Investigation was begun to discover what might be termed the etiologic occupations. In this connection, Cooke[61] found pneumoconiosis due to flue dust; Lawson, Jackson and Gardner[62] found it in iron miners, and Gudjonsson[63] found silicosis among women employed in the manufacture of scouring powder. One of the outstanding features of the condition is that symptoms may not develop until some years after the exposure to the causative agent has ceased. Britton and Head[64] report four such cases in which the interval between exposure and development of symptoms was from ten to twenty-three years. In 1925, Pancoast and Pendergrass reviewed the subject of pneumoconiosis; and in 1931 they have published a second review,[65] in the latter, limiting themselves to the advances made since the former. They stress the economic phases, the newness of the subject, the importance of the roentgen examination, and the necessity for the roentgenologist to familiarize himself with the roentgen picture. They also suggest a new pathologic-roentgenologic classification.

*Asbestosis.*—One of the etiologic occupations which produces chronic pulmonary disease is work in asbestos. Lynch and Smith[66] survey the literature and describe the condition in detail. They found only 173 cases of pulmonary asbestosis previously reported in the literature, six of which were their own, and they add one more. They base their diagnosis on the clinical, roentgen, or necropsy findings. Clinically, they examine the sputum or lung juice obtained by puncture, for the presence of asbestosis bodies. In December, 1930, there appears the report of a case by Soper[67] which he diagnosed by demonstration of the bodies in the sputum. Lynch and Smith did not mention it. Stewart, Bucher, and Coleman[68] also report two more cases of asbestosis. In their first case, the symptoms were relatively unimportant; in the second, the disease was concomitant with tuberculosis. They found asbestosis bodies may be harbored by the spleen and lymph nodes as well as by the lung. They urge study in order to prevent the disease.

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[59]Am. Jour. Roentgenol. and Rad. Ther., September, 1931, XXVI, 408.
[60]Rev. esp. de tuberc., June, 1931, II, 253.
[61]Brit. Med. Jour., November, 1930, II, 816.
[62]Jour. Am. Med. Assn., April 4, 1931, XCVI, 1129.
[63]Ugeskr. f. Laeg., Sept. 10, 1931, XCIII, 926.
[64]Jour. Am. Med. Assn., June 6, 1931, XCVI, 1938.
[65]Am. Jour. Roentgenol. and Rad. Ther., October, 1931, XXVI, 556.
[66]Am. Rev. Tuberc., June, 1931, XXIII, 643.
[67]Ibid. December, 1930, XXII, 571.
[68]Arch. Pathol., December, 1931, XII, 909.

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### THYMUS

In spite of the "passing of Status Lymphaticus," as the London Correspondent of the *Journal of the American Medical Association*[69] terms it, in commenting on the report of the joint committee[70] (of the Medical Research Council and the Pathological Society of Great Britain and Ireland), valuable material concerning the thymus glans is constantly appearing. Boyd,[71] reporting to the White House Conference on the growth and function of the thymus, states that the roentgen information has not been as carefully analyzed as has other information on the gland. She feels there is a need for standards based on healthy symptom-free children. Fanconi's[72] discussion of the pathology of the superior mediastinum is especially pertinent in the evaluation of thymic enlargement. He shows that since the roentgenogram is the result of a superposition of the sternum, thymus, large vessels and the vertebræ, it may be disturbed by variations in any of them. He says narrowing is especially characteristic of transposition of the great vessels, and that the chief cause of widening is thymic hypertrophy. He also discusses the significance of various lines within the mediastinal outline. Krizeneky's[73] experimental work on pigeons permits him to conclude that the thymic gland acts as a regulator of thyroid function. Dustin and Grégoire[74] note that the thymus of irradiated pregnant guinea pigs evidences a state of involution which increases with the age of the animal and the length of pregnancy. In the thymus glands of fetuses of these females, radiation produces rapid and massive pyknotic degeneration. When the small thymic cell is developed it at once acquires a decided hypersensitivity to radiation. After radiation, Hassall's corpuscles develop all along the vascular framework and undergo considerable hyperplasia. Kennedy and New[75] discuss conditions that may produce chronic stridor "sometimes erroneously attributed to enlargement of the thymus." Pancoast[76] feels that the "thymic menace" in infants and children is largely a matter of tracheal stenosis, and consequently he offers a new technic for the roentgen examination. Donaldson[77] reports on 1,045 patients with hyperplasia of the thymus. He found a tendency to familial enlargement, but doubted if there was a connection between the "thyroid mother and the thymic infant." The mother's age, multiparity and obesity of the parents, had no bearing on the size of the thymus in the child. He urges early diagnosis as vital and advises treatment, but his technic is poorly outlined. Frank[78] treats only if there are symptoms of pressure. Johnston and Howard[79] feel that in an infant who presents noisy, difficult, or rapid breathing, it is necessary to rule out other cause before narrowing down to a di-

[69]Jour. Am. Med. Assn., June 6, 1931, XCVI, 1963.
[70]Jour. Path. and Bact., March, 1931, XXXIV, 213.
[71]Am. Jour. Dis. Child., July, 1931, XLII, 205.
[72]Schweiz. med. Wchnschr., March 7, 1931, LXI, 229.
[73]Compt. rend. Soc. de Biol., Feb. 6, 1931, CVI, 325.
[74]Ibid, Sept. 18, 1931, CVII, 1565.
[75]Jour. Am. Med. Assn., April 18, 1931, XCVI, 1286.
[76]Am. Jour. Med. Sci., December, 1930, CLXXX, 745.
[77]Am. Jour. Roentgenol. and Rad. Ther., November, 1930, XXIV, 523.
[78]Jour. Am. Inst. Homeop., June, 1931, XXIV, 553.
[79]Jour. Michigan St. Med. Soc., November, 1930, XXIX, 772.

agnosis of thymic enlargement. When convinced of the necessity, they treat, but since they feel that thymic enlargement responds rapidly to X-ray therapy, if there is not immediate improvement they doubt the diagnosis.

*Psoriasis.*—Speirer[80] reports ten years' experience in the treatment of psoriasis by roentgenography of the thymus. He did not obtain a single permanent cure among 50 cases treated, although he noted temporary disappearance of lesions in a few. There were recurrences within a year, those who did respond were mostly young patients, sex and variations of technic were not factors. He feels that there may be a connection between psoriasis and tuberculosis because of the beneficial effects following exposure over the upper mediastinum which could be due to an effect upon the glands in that region, since it is well known that tuberculous glands respond to treatment. He does not believe there is any stimulation effect.

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TUBERCULOSIS

As usual, the amount of material published on the subject of tuberculosis is staggering, and much of it is repetitious. Due to the limited amount of space, any material not pertinent to the radiologic angle has been eliminated.

*Diagnosis.*—The diagnosis of pulmonary tuberculosis is a moot subject. The early infiltrations and diagnosis of the disease in both children and adults have received a large amount of attention. Meyer[81] writes on what he terms "pretuberculosis," and Ligner[82] calls the pre-allergic period that interval of from three to five weeks during which infection by the air route is without sign until the appearance of allergy. This is accompanied by a triad—sensitiveness to tuberculin, a period of fever, and a thickening of the hilus in one lung or the other. Reid,[83] Wiewiorowski and Bödecker,[84] Brauening,[85] and Delherm and Thoyer-Rozat[86] all urge the periodic radiologic examination of apparently healthy persons as a means of revealing previously unsuspected tuberculosis. They feel the early treatment which must necessarily ensue is an important public health and preventive disease measure. Lawrason Brown[87] is convinced the roentgen examination will reveal lesions of the disease long before it is manifested in any other way, while Sampson's and his[88] experimental and statistical studies prove the efficacy of roentgen examination for pulmonary tuberculosis. Stayton[89] and Menville[90] second Brown's statement, but the former also believes the roentgen and clinical examinations should be entirely independent of each other, while the latter urges more encouragement of frequent consulta-

[80]Strahlentherapie, 1931, XL, 272.

[81]Med. de los niños, January, 1931, XXXII, 6.

[82]Ztschr. f. Kinderh., 1930, L, 505.

[83]New York St. Jour. Med., March 15, 1931, XXXI, 337.

[84]Fortschr. a. d. Geb. d. Röntgenstr., June, 1931, XLIII, 679.

[85]Ztschr. f. Tuberk., May, 1931, LX, 273.

[86]Paris médical, Feb. 7, 1931, I, 117.

[87]Am. Jour. Med. Sci., November, 1931, CLXXXII, 700.

[88]Am. Jour. Roentgenol. and Rad. Ther., February, 1931, XXV, 209.

[89]Indiana St. Med. Assn. Jour., Feb. 15, 1931, XXIV, 85.

[90]New Orleans Med. and Surg. Jour., December, 1930, LXXXIII, 370.

tion between internist and roentgenologist. Casati[91] notes three principal causes of error to explain the lack of agreement between the clinical and roentgenologic observations in pulmonary tuberculosis. These are: (1) the absence of complete agreement between the roentgen observations and the pathologic anatomy; (2) absence of agreement between the clinical and the anatomopathologic observations, and (3) a certain fixed nature of the roentgen picture in the sense that the anatomopathologic lesions change slowly in the roentgenogram, more slowly than in the clinical picture. Pai[92] feels that roentgenology has great advantages over physical means in the diagnosis of tuberculous hilus disease, circumscribed pneumothoraces, pleural effusions, and occluded cavities. Basu[93] considers the roentgenologic examination of the lungs superior to the physical in the following conditions: (1) early tubercle complicated by bronchitis; (2) deep-seated and closed early lesions; (3) hilum tuberculosis; (4) recrudescences of old lesions, and (5) necessity for artificial pneumothorax therapy. He advises correlation of both examinations. Wulff and Myers[94] cite two groups of cases in which they feel that the chest findings warrant far more consideration than they usually receive. The first group includes patients who have mild symptoms from time to time, but in whom no evidence of pathology can be detected other than definite calcium deposits in the hilus region with or without accompanying Ghon tubercles. The second group comprises patients with the same findings but in whose families tuberculous infection has spread to nearly all the members, and in which one or more clinical cases of tuberculosis has developed. Zihelnik's[95] study of a large number of ambulatory patients who had been diagnosed as having pulmonary tuberculosis prompts him to urge constant demonstration to the "ambulatory physician" of the importance and necessity of the most extensive use of roentgenography in suspicious cases.

The primary focus of tuberculous infiltration is also a considerably discussed point. Fleischner[96] is inclined to belief in the "Frühinfiltrat" of Assmann and Redeker which he describes as a decidedly exudative focal picture. He says that the diagnosis is more often made by roentgenologic than by clinical means because of the lack of definite outstanding clinical signs. Infraclavicularly, there is a pale, patchy shadow of different densities. The position of the focus may be higher, but seldom in the apices. It often lies deep in the upper lobes, and occasionally in the apices of the lower lobes. Very early foci show homogeneous, distinctly outlined shadows. Shadows striating toward the hilus often lead to the impression of lymphangitis and the inflammatory edemas of the large perivascular and peribronchial interstices. Sorrentino's[97] examination of 1,000 tuberculous patients, in whom he found 20 cases of the infiltrate in its pure form, would seem to substantiate its importance. Staub[98] urges that both it and apical tuberculosis be sought for. It is questionable how sound is the basis for Fischel's[99] controversial statement that apical tuberculosis as a rule is a benign late form. Sagona's[100] experimental work indicates that the tubercle bacillus in small doses or as ultravirus has a special predilection for the lymph nodes. Herrman[101] says that, roentgenologically, the primary focus of infection should manifest itself as an infiltrative process, but the majority of cases show reinfection foci with perifocal infiltration which may appear in any part of the lung.

[91]Gior. di Clin. Med., Feb. 28, 1931, XII, 157.
[92]Antiseptic, July, 1931, XXVIII, 506.
[93]Ibid, July, 1931, XXVIII, 510.
[94]Med. Jour. and Record, Dec. 3, 1930, CXXXII, 527.
[95]Vrachebnaya Gazetta, April 15, 1931 VII, 501.
[96]Wien. klin. Wchnschr., Feb. 20, 1931, XLIV, 267.
[97]Rif. Med., Feb. 23, 1931, XLVII, 285.
[98]Schweiz. med. Wchnschr., Feb. 14, 1931, LXI, 157.
[99]Am. Rev. Tuberc., February, 1931, XXIII, 139.
[100]Riv. di Pat. Clin. di Tuberc., Aug. 31, 1931, V, 670.
[101]Kentucky Med. Jour., August, 1931, XXIX, 393.

The amount of inflammatory change appearing as an allergic reaction depends on the degree of the patient's immunity. De-Benedetti[102] thinks that tuberculous "hilitis" enters into the picture of the primary infection in children and is the typical roentgen expression. Schulz[103] uses the oblique roentgenogram to demonstrate enlarged bronchial lymph nodes which he believes to be the site of tuberculous infection in adults much more often than is thought.

*Public Health.*—That tuberculosis is inherently a public health problem is amply evidenced by the increased interest in its control which is being exhibited by local and national public health agencies both in the United States and elsewhere. There are reports of current problems and advances from Germany, Italy, France, England, Denmark, Sweden, Hawaii, and the Netherlands. Italy held its fourth National Congress for the Crusade against Tuberculosis[104] in Bologna, in October, 1931; the fourth Polish Conference on Tuberculosis[105] was held at Zakopane in September, 1931, and the Roumanian League against Tuberculosis held its first National Congress[106] in July of that year.

Wingfield[107] is interested in the general practitioner's clinical problem with the child in the tuberculous household. He urges proper hygiene in the home, but he feels that it is a serious responsibility and "would be a waste of his time and injurious to his practice" for the physician to say to a tuberculous mother that she must never see her child again. He believes that the adolescent period is the most dangerous one, and that then the roentgenogram is particularly useful, for "apical infiltration in childhood and adolescence, although apparently latent, always goes on to definite clinical pulmonary tuberculosis if untreated." Dixon,[108] on the other hand, stresses the communicability of tuberculosis and the fact that it is, therefore, a family disease. He urges removal of children from homes which have a source of infection. Klein[109] calls attention to the necessity for health examinations of teachers and of students in pedagogic institutes, because of the danger of subsequent contact for children in their classes. His work is based on experience with several class infections which could be traced to teachers with open tuberculosis.

*Value of Roentgen Examination.*—There are a number of surveys of tuberculosis in adults and children. Although Eberson, Delprat, and Wolff[110] conclude that the roentgen evidence is of no value for the diagnosis of tuberculosis unless associated with other positive signs; and Paolucci and Busi,[111] reporting their findings on 300 children in a small Italian town with a known high incidence of tuberculosis, warn against placing too much emphasis upon the roentgen findings, the majority of investigators all over the world are commendatory of the importance and value of the roentgen examination in diagnosis. Filgueiras,[112] of Rio de Janeiro, feels that roentgenograms are the best means of diagnosis in early infancy, Budson[113] reports that Armand-Delille considers the X-ray to be the only positive diagnostic means for the early recognition of enlarged tracheobronchial glands, and Altschul[114] says that although the roentgen diagnosis of tuberculosis of the bronchial glands is not reached as often as it should be, especially in children, and although certain groups of glands cannot be exhibited in the roentgenogram because they fall within the middle shadow, nevertheless the roentgen examination constitutes the most important part of the whole examination of

[102]Clin. Ped., October, 1931, XIII, 769.
[103]Ztschr. f. Tuberk., March, 1931, LX, 24.
[104]Jour. Am. Med. Assn., Sept. 12, 1931, XCVII, 793.
[105]Ibid, March 5, 1932, XCVIII, 830.
[106]Ibid, Sept. 12, 1931, XCVII, 792.
[107]British Med. Jour., Oct. 31, 1931, II, 787.
[108]Ibid, April 25, 1931, I, 694.
[109]Ztschr. f. Tuberk., December, 1931, LXIII, 22.
[110]Am. Jour. Dis. Child., October, 1930, XL, 853.
[111]Bull. Union Internat. Tuberc., 1930, VII, 2.
[112]Arch. Pediat., January, 1931, II, 77.
[113]Jour. Michigan St. Med. Soc., January, 1931, XXX, 19.
[114]Radiology, December, 1931, XVII, 1147.

the hilus and an accurate diagnosis of hilus involvement is impossible without it. Lestocquoy[115] feels that the monthly roentgen examination of tuberculous children is absolutely necessary, and Stone and Wolff[116] found that by means of the X-ray the positive diagnosis of tuberculosis was established in 28 per cent more of the children they studied than by any other method. From their study of 1,000 adolescent school children in New York City, Barnard, Amberson, and Loew[117] rank the X-ray examination as of great value, and Forbes, Verploeg, and Bazemore[118] conclude from their survey in the schools of a small Colorado town whose pupils were mostly tuberculosis contacts, that symptoms of fatigue and underweight and a history of frequent colds were not reliable in the diagnosis of the childhood type of tuberculosis. Hetherington and his associates,[119] studying medical and college students by means of the roentgen and other examinations, report a high incidence of apical tuberculous lesions in the medical students. These increase rapidly from the age of twenty-one to twenty-six years, and indicate that medical students are peculiarly subject to advanced tuberculous infection. Myers'[120] article showing the increase in tuberculin-positive reactors among nurses and students of medicine after exposure in tuberculous services, has created considerable comment.

*Basic Material.*—There are several good basic articles on tuberculosis in childhood which are valuable, not because of necessarily new material, but because of the sound reasoning behind the information they reiterate. The authors are Hempelmann,[121] Chadwick,[122, 123] and Krause.[124] The last named is opposed to too much attempt at classification; he feels it is sufficient to term a condition "active" or "inactive."

*Classification.*—In regard to classification, Ornstein, Ulmar, and Dittler[125] describe a condition which they call "benign acute pulmonary tuberculosis," the chief characteristic of which is that it disappears completely within from a few weeks to a few months, with complete healing. They report 58 cases, with a description of typical histories, symptoms, physical signs, roentgen findings, and treatment. In a second article,[126] they offer a new classification for pulmonary tuberculosis because they believe the one now in use does not indicate the possibility of the patient's recovering. Shipman[127] merely substantiates the use of the "exudative-proliferative" classification. Sims[128] thinks that although there are many classifications of pulmonary tuberculosis, both clinical and pathologic, the most logical one to him is the one based on the pathologic stage or phase of the disease; exudative infiltration and caseation, including cavitation; fibrotic infiltration, and calcification. Henricke[129] is averse to any more classifications of tuberculosis, because of the number already extant, but, after due consideration, he offers another which he feels conforms to the present terminology and knowledge. The name he suggests is "benign infiltrations in the childhood type of epituberculosis," and he suggests four classes: (1) massive infiltrations (splenopneumonia); (2) lobar infiltrations (the epituberculosis of Eliasberg and Neuland, *Jahr. f. Kinderh.*, 1920, XCIII, 88); (3) perihilar infiltrations, and (4) perifocal infiltrations. He believes the condition presents a symptom-complex which is just as interesting as it is poorly

[115] Médecine, May, 1931, XII, 361.
[116] RADIOLOGY, November, 1931, XVII, 940.
[117] Am. Rev. Tuberc., May, 1931, XXIII, 593.
[118] Am. Jour. Dis. Child., January, 1931, XLI, 26.
[119] Arch. Int. Med., November, 1931, XLVIII, 734.
[120] Jour. Am. Med. Assn., Aug. 1, 1931, XCVII, 316.
[121] Jour. Missouri St. Med. Assn., November, 1930, XXVII, 519.
[122] Jour. Mich. St. Med. Soc., January, 1931, XXX, 15.
[123] Am. Jour. Roentgenol. and Rad. Ther., January, 1932, XXVII, 46.
[124] Ann. Int. Med., May, 1931, IV, 1424.
[125] Am. Rev. Tuberc., March, 1931, XXIII, 223.
[126] Ibid, March, 1931, XXIII, 248.
[127] Calif. and West. Med., March, 1931, XXXIV, 172.
[128] New Orleans Med. and Surg. Jour., March, 1931, LXXXIII, 631.
[129] Northwest Med., March, 1931, XXX, 109.

understood. Loben,[130] believing that the roentgen diagnosis is probably superior to all other methods, distinguishes three main groups according to the roentgen appearance: (1) infiltrative processes and their localized sequences; (2) the disseminated forms; (3) ulcerative, cavernous, mostly exudative phthisis. He says that one cannot always classify a case, but he advises doing so as far as possible. Goldberg and Gasul[131] cling to the term "epituberculosis," and under that title, they report a clinical and roentgenologic study of ten cases which they observed for over two years. Later,[132] they report another case that was complete even to the autopsy findings which are rarely on record for this condition.

*Relation to Skin Condition.*—Dickey[133] reports eight cases (from the pediatric service of the Stanford Medical School), in which erythema nodosum was associated with tuberculous infection which was demonstrable in radiographs. He believes the skin condition bears very close relation to early tuberculous infection.

*Miliary Tuberculosis.*—Seven cases of miliary tuberculosis are reported—each because of a rare complication, peculiar manifestation, source of infection, type of treatment, or the fatal or healed termination. One of Stamm's[134] cases evidenced pulmonary tuberculous involvement and erythema nodosum, seeming to support Dickey's belief in the relation of the two conditions. In the case reported by Voron and Pizzera[135] the evidence seemed to indicate that the infection had been acquired *in utero*.

*Pneumothorax Therapy.*—Pneumothorax therapy in tuberculosis is constantly undergoing change and improvement. Adler[136] urges constant roentgen control; Poix and Bosnieres[137] report an elaborate and seemingly effective method of administering it without hospitalization; Bader[138] calls attention to the danger of subsequent re-expansion after release if a fibrin coating has formed over the pulmonary pleura. Blechmann, Kindberg, and Cottentot[139] believe their patient is the youngest on whom pneumothorax has been attempted for pulmonary tuberculosis with cavity formation. It was performed at the age of five months, and at sixteen and one-half months the child's condition was excellent and the cavity no longer evident. Beal's[140] six cases of symptomless spontaneous pneumothorax were all discovered in the course of routine examination of patients who had pulmonary tuberculosis. In five of the cases, the diagnosis was confirmed roentgenologically; the other patient was too ill for the examination.

*Correct Diagnosis.*—Briskman[141] calls attention to the possibility of confusing undulant fever and pulmonary tuberculosis. His report of two such cases which were sent to the Union Printers Home in Colorado Springs by mistake, motivates the warning. Frothingham,[142] speaking before the National Tuberculosis Association, stresses the importance of obtaining a correct diagnosis between pulmonary tuberculosis and pulmonary or bronchial malignant neoplasms, because of the wide difference in methods of treatment. He gives an exhaustive discussion of 39 cases of primary pulmonary malignancies and 16 cases of secondary manifestations, and concludes that because of the similarity of pulmonary carcinoma and tuberculosis, the serial X-ray is the best aid to diagnosis. Kornblum and Ellison[143] report four cases of atypical pulmonary tuberculosis which, in the final stages of healing, presented certain difficul-

[130]Med. Klin., May 22, 1931, XXVII, 763.
[131]Am. Jour. Med. Sci., December, 1930, CLXXX, 824.
[132]Am. Rev. Tuberc., September, 1931, XXIV, 285.
[133]Am. Jour. Med. Sci., October, 1930, CLXXX, 489.
[134]Monatss. f. Kinderh., December, 1930, XLVIII, 497.
[135]Bull. Soc. d'obst. et de gynéc., April, 1931, XX, 283.
[136]Ztschr. f. Tuberk., May, 1931, LX, 434.
[137]Presse méd., Nov. 8, 1930, XXXVIII, 1513.
[138]Ztschr. f. Tuberk., July, 1931, LXI, 209.
[139]Jour. Am. Med. Assn., May 16, 1931, XCVI, 1712.
[140]British Jour. Tuberc., January, 1931, XXV, 21.
[141]Am. Rev. Tuberc., October, 1931, XXIV, 246.
[142]Ibid, February, 1931, XXIII, 107.
[143]Am. Jour. Roentgenol. and Rad. Ther., May, 1931, XXV, 620.

ties of interpretation roentgenographically. The disease was rather sharply limited to a part or the whole of one lobe, with only scattered infiltrations in the rest of the same or the opposite lung. They state that an important diagnostic point for the roentgenologist is displacement of the hilus on the side of the lesion. There it is drawn upward. Stein's[144] patient died of tuberculous meningitis, and the important feature of the case was the presence of a large cavity in the left lung which contained fluid filled with cholesterol crystals. The probability of a tuberculous pleurisy twenty-five years previously, prompts the author to theorize as to the etiologic connection between cholesterol-thorax and tuberculosis.

*Tuberculous Lobitis.* — Malugani[145] reports ten cases, nine of which were tuberculous lobitis and one upper right interlobar pleurisy, included for purposes of differentiation. He says the condition of tuberculous lobitis is rare, and varies with the type, which may be one of three. It may show: (1) homogeneous opacity; (2) non-homogeneous opacity, with a "bird's nest" or "bread crumb" aspect, or (3) non-homogeneous opacity, with a single zone of more normal clearness (cavity). He feels the diagnosis is relatively easy, because it is characterized by opacity of a whole lobe, with or without cavity formation, and a distinct outline following the interlobar fissure. It is relatively benign.

*Surgical Tuberculosis.*—Lambranzi[146] describes the roentgen picture of pulmonary tuberculosis in persons with surgical tuberculosis. It is evidenced in a typical fibrous condition which usually progresses slowly and especially in the early stages causes few or no characteristic symptoms. He believes that surgical tuberculosis has an immunity effect which retards development of the lung infection.

*Healing.*—Anderson[147] and Fales[148] write timely reminders of the instability of apparent arrests in chronic tuberculous disease. From Beaudet's[149] report of six cases, he concludes that tuberculosis heals by absorption or by fibrosis, and that the former is by far the more common form of repair, as evidenced in the gradual clearing in serial roentgenograms. He believes that fibrosis can be, and frequently is, absorbed, and that therefore it is, to some extent, a stage in the healing process.

*Cavities.*—Saley's[150] analysis of tuberculous cavities and results of artificial pneumothorax therapy in 31 cases is a valuable one for the phthisiologist who uses that therapeutic device. His classification of cavities as to type conforms to that of Pinner and Parker,[151] which is based essentially on the factor of fibrosis. They recognize three types: (1) moth-eaten areas in the infiltrated parenchyma; (2) round or oval cavities, and (3) fibrotic irregular cavities. Sweany, Cook, and Kegerreis[152] report a statistical study of the position of primary cavities as determined by means of stereoscopic X-ray films. They found about 98 per cent of the cavities situated on bronchi that are directed rather sharply posteriorly, and the posterior aspect of the bronchi seemed to be the most important factor. Nearly all cavities were infraclavicular; the distribution of the lesions as to the side of the lung was directly proportional to the lung volume of the respective sides; the position of the cavities indicated a common factor of origin and suggested a bronchogenic origin, and the posterior subapical bronchial rami, the apical, horizontal and those of the apex of the lower lobe were

[144]Arch. Int. Med., March, 1932, XLIX, 421.
[145]Arch. di radiol., 1930, VI, 763.
[146]Radiol. med., 1930, XVII, 1183.
[147]U. S. Vet. Bur. Med. Bull., June, 1931, VII, 561.
[148]Med. Bull. Vet. Admin., December, 1931, VII, 1121.
[149]U. S. Vet. Bur. Med. Bull., July, 1931, VII, 643.
[150]Am. Jour. Roentgenol. and Rad. Ther., February, 1931, XXV, 231.
[151]Am. Jour. Roentgenol. and Rad. Ther., April, 1931, XXV, 454.
[152]Am. Rev. Tuberc., November, 1931, XXIV, 558.

the only significant ones. Fales and Beaudet,[153] incited by the statement made by Pinner (who was quoting Graeff) that the tuberculous cavity is the death sentence of its bearer, surveyed 120 cases of pulmonary tuberculosis with 147 cavities. They found that a surprisingly large number healed, that the ability of a cavity to heal depended upon its size and the amount of involvement, that therapeutically the rest treatment seemed of greater importance than surgical measures, and that the prognosis was not good if the cavitation was bilateral. Werner and O'Brien[154] summarize and tabulate their results on 200 cases of pulmonary tuberculosis with cavities three millimeters in diameter or larger. Their results are conditioned by important factors to which justice cannot be done in abstract, consequently the article should be studied in the original. Mitchell[155] discusses the annular shadows in the lungs (excluding ordinary tuberculous cavities) which are so puzzling to most radiologists. He calls them "air cysts," and believes that usually they represent air spaces in the lungs produced by perforation of a small bronchus, with escape of air into the connective tissues in the form of a single bubble. Rapid increase in size may result from a ball-valve action between the bronchus and the air space by allowing air to enter the "cyst." However, if the point of perforation is healed over, then there may be rapid absorption of the enclosed air and decrease in the size of the shadow. He believes these shadows are pathognomonic of tuberculosis even though pulmonary fibrosis is not evident.

*Therapy.*—From the published results of various investigators, ultra-violet radiation would seem to be of value in cases of catarrhal bronchitis or bronchitis of long standing, tuberculous adenitis, and pleuritis, skin and other superficial conditions. It is of questionable value in the treatment of pulmonary tuberculosis. Murray[156] found improvement in two of 26 cases, and Kettelcamp[157] noted some fibrosis in patients with pulmonary tuberculosis who were treated for tuberculous enteritis, but he feels that the significance is doubtful. In Sepke's[158] report of 400 cases from 1,600 which he has treated with a combination of ultra-violet and natural sunlight, he advises not radiating the more active types, especially the exudative forms. Mozdien[159] found that a combination of local X-ray therapy and general light exposure gave the best response in a number of patients with tuberculous glands. Schulte-Tigges[160] states that patients with productive pulmonary tuberculosis who are fever-free, or the cirrhotic cavernous types without elastic fibers in the sputum, may be given roentgentherapy, but that irradiation is contra-indicated in patients with fresh infiltrative or active exudative processes. Altschul and Schiller[161] consider roentgentherapy indispensable as an auxiliary method in the treatment of surgical tuberculosis. Kaminsky and Davidson[162] studied 16 persons and found that, judging from the roentgen evidence, the oral administration of small doses of irradiated ergosterol augmented the serum-calcium concentration of patients with pulmonary tuberculosis; but such increase did not seem to influence the degree of calcification of lung lesions to any appreciable extent. Trepiccioni and di Natale[163] used direct roentgentherapy in 14 cases of pulmonary tuberculosis: six cases showed "benefit," six showed "some," and two showed roentgen and clinical clearing of cavities and disap-

[153] Am. Rev. Tuberc., June, 1931, XXIII, 690.
[154] Am. Jour. Roentgenol. and Rad. Ther., December, 1930, XXIV, 620.
[155] British Jour. Radiol., April, 1931, XVI, 602.
[156] British Jour. Actinoth. and Physioth., October, 1930, V, 135.
[157] Arch. Phys. Ther., September, 1931, XII, 527.
[158] Med. Klin., May 22, 1931, XXVII, 771.
[159] Strahlentherapie, Jan. 31, 1931, XXXIX, 507.
[160] Schweiz. med. Wchnschr., April 25, 1931, LXI, 408.
[161] Strahlentherapie, 1931, XLI, 755.
[162] Am. Rev. Tuberc., October, 1931, XXIV, 483.
[163] Lotta Con. la Tuberc., August, 1931, I, 842.

pearance of the tubercle bacillus from the sputum. The last two had had phrenic exeresis previously. The authors believe the results were due to the combined effect of the two therapeutic measures.

*Larynx.* — Gelfon and Panow[164] used roentgenoscopy in the diagnosis of tuberculosis of the larynx in connection with the clinical and laryngoscopic findings to localize the process and show its extent and depth. Sylla[165] found certain peculiarities in the roentgenograms of 128 patients with pulmonary and laryngeal tuberculosis. These were of three types: (1) cavernous pulmonary tuberculosis, with a predominance of large foci disseminated over both lungs; (2) hematogenic dissemination, and (3) cirrhosis of the upper portion of the lung and peculiar dissemination in the lower lobes. He considers the etiology of these various conditions, and discusses the histologic examinations and the possible therapeutic means. Galland and Rautureau[166] describe the lesions they found in the lung roentgenograms of nine cases with tuberculous laryngitis. They found the lesions were diffuse, almost entirely bilateral, always localized in the upper portion of the lung fields, occasionally in the apices only. There was no invasion of the bases, but, in time, there was marked involvement of the parenchyma. They believe that primary tuberculous laryngitis does not exist, but that it is effected by the lymphatic route, by infection from the tracheobronchial, mediastinal, and cervical glands rather than by direct infection. An important roentgen finding is a finely disseminated, granular-like process developing in both apices, with retention of these characteristics throughout the course of the disease.

*Sarcoid.*—Michelson[167] reports a case of sarcoid in a girl 26 years old, in which there was pulmonary involvement also. The skin lesions responded to X-ray therapy, but deep therapy over the lungs did not produce noticeably definite changes in the lung findings. In the article by Kirklin and Morton,[168] they discuss the subject fully, and state that "when Boeck's sarcoid occurs with visceral involvement, characteristic changes may be observed in roentgenograms of the bones and of the lungs." The latter show diffuse infiltration and mottling usually in the lower and middle portions.

*Measles.*—Mikulowski[169] calls attention to pneumonic phthisis of measles in infancy and its frequency.

*Sinus Examination.*—Osmond[170] reports five cases which prompt him to stress the importance of sinus examination in cases of questionable pulmonary tuberculosis or other chest infections.

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*(Section on the Thorax, beginning with Tumors, to be continued.)*

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*Plan High Voltages and Low Temperatures to Explore Interior of Atom.*—Two new programs of research at Princeton University call for the development of apparatus capable of producing millions of volts of static electricity and a liquid hydrogen laboratory which will make possible temperatures around 400 degrees below zero Fahrenheit. By means of these extreme voltages and intensely low temperatures, it is hoped to learn more about the forces which hold atoms and molecules together in solid crystals and the laws governing the geometrical patterns of their arrangement. More information concerning the forces which hold solids together is important commercially in determining and modifying the strength of materials for industry.

Prof. Rudolph Walter Ladenburg, who has been associated with the Kaiser Wilhelm Institut fur Physikalische Chemie in Berlin, has been added to the faculty to take charge of these new fields of research. He succeeds Prof. Karl T. Compton, who resigned two years ago to become president of the Massachusetts Institute of Technology.—*Science Service.*

# PNEUMONIA, ROENTGENOLOGICALLY CONSIDERED

By A. G. SCHNACK, M.D., Queen's Hospital, HONOLULU, T. H.

IN spite of the great amount of experimental work done on the etiology of the various types of pneumonia, there is still a great deal of uncertainty and controversy concerning many of the basic factors entering into the development of acute lung consolidations. Until these controversial elements, which in great part deal with the mechanical factors of consolidations, are thoroughly understood, they will tend to produce confusion in diagnosis and therapy. I aim to present a few facts from recent experimental work which seem to explain the sequence of events in pneumonic consolidations, and to show how these facts can be utilized to a great degree in the diagnosis, and, to some extent, in judging the future course of a pneumonic infection.

A number of articles have recently appeared on experimental and pathologic atelectasis and its subsequent effects on the involved lung tissue. Coryllos and Birnbaum (1) have beautifully demonstrated the ease with which atelectasis of a desired lobe in a dog's lungs may be produced. They introduce, through a bronchoscope, a dilatable rubber bag, and make a study of the results of introducing different organisms to produce specific types of pneumonia. Their conclusion that pneumonia always begins with an atelectasis has much support from roentgenologic evidence. An abbreviated résumé of their remarks follows.

"Atelectasis and pneumonia have a common pathogenesis. Incomplete bronchial obstruction leads to emphysema. Complete bronchial obstruction interferes with the ventilation, circulation, and drainage of the involved lung, and atelectasis and cellulitis result. The degree of cellulitis depends upon the virulence of the infecting organism and the duration of the obstruction. Lobar and lobular atelectases, with the resulting lobar and lobular pneumonia, are due to the occlusion of bronchi of different sizes by mucous exudate and bronchial mucosa edema. Whether we have a lobar or lobular atelectasis and pneumonia depends for the most part on the type of organism in the occluding exudate. Organisms producing much edema or thick exudate occlude larger bronchi.

"Type IV pneumococcus, present in the main bronchi of 80 per cent of people, is the most common organism causing bronchial edema and obstructing mucous exudate. Less viscid exudates, such as those produced by influenza, staphylococcus, and streptococcus, cause obstruction of smaller bronchi and bronchopneumonia. Abdominal operations, regardless of the type of anesthesia, due to stasis of bronchial secretion, posture, and splinting of the thorax, are apt to initiate bronchial obstruction. Absorption of the air results in atelectasis and subsequent pneumonia. Foreign bodies and bronchial tumors may do the same. The serum exudate, containing antitryptic ferments, continues to obstruct for several days. Between the fifth and eleventh days, the cellular exudate, through disintegration, liberates a proteolytic ferment which neutralizes the antitryptic ferments, whereupon digestion of the thick exudate suddenly releases the back pressure upon the involved lung tissue, allowing lung drainage to a greater or lesser degree. At this point, the so-called 'crisis' appears. Acidulating the bronchial secretion with carbon dioxide hastens the proteolytic action. Roentgentherapy through destruction of the white blood cells is credited with liberation of excess proteolytic ferment, and hastening the crisis and subsequent clearing process. (The sudden re-

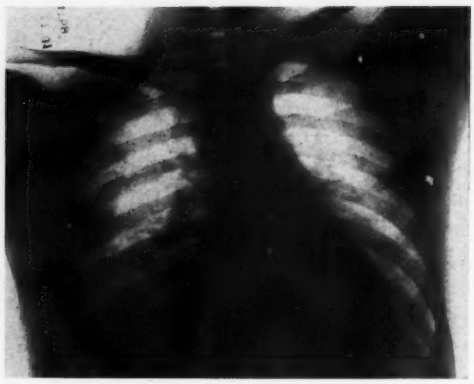

Fig. 1-*A*. Case 1. Film made on July 17 shows the right chest volume greatly reduced and the right diaphragm high. No lung clouding was apparent.

lease of the bronchial obstruction may be likened to the sudden drainage of a boil, which is quickly followed by subsidence of symptoms.) If the blockage is maintained, abscess or gangrene may result.

"Theories have been brought forward by Cutler and others to show that pneumonia is, in reality, due to embolism of the terminal arteries, but this is not borne out by findings, which show for the most part the arteries patent and ready to resume full function when the compressing exudate is released."

The roentgenologic findings all fit in much better with the atelectatic-origin theory of pneumonias. Certain roentgenologic findings are of value in predicting, to a certain extent, the lobes which will be involved before actual lung consolidation can be detected on the X-ray film. Lung lobes may be involved without visible consolidation in the plate but, by physical examination, give signs of consolidation. It is quite probable that atelectasis of lung tissue from bronchial obstruction need not go on to actual lung consolidation, or only to patchy areas of consolidation. Atelectasis of early infancy is generally not associated with pneumonic consolidation, although the alveoli may be partly filled with exudate.

From the clinical side, on close scrutiny of individual cases, many varying observations may be made. The frank lobar pneumonias with sudden onset, giving almost from the start all the necessary earmarks of extensive consolidation, are in marked contrast to many of the lobular pneumonias. These are often preceded by an upper respiratory infection which, if the cough did not direct us to examine the chest closely, might pass undetected. We speak of central pneumonias (3) because we are unable to determine parenchymal consolidation. Diminished breath sounds and, a little later, râles are the only clues by which to estimate the significance of a rising temperature, rapid pulse, cough, etc. Atelectasis in its early states, with only a beginning cellulitis, can easily explain our findings upon physical examination. It is a remarkable fact that, during the early stages of a pneumonia, our roentgenographic evidence of consolidation may be practically *nil*. In some cases if we fail to take into consideration all the concomitant evidence, we may never definitely demonstrate the location of the involved lung. The exudate may be too faint to cause a definite roentgenographic shadow at any time during the lung involvement; again one may observe a small area of exudate grow from day to day on the roentgenographic plates. That a consolidated lung is generally apneumatic would, of course, explain immediately why it is smaller than the pneumatic lung as it usually exists in the chest.

It has been taken for granted that, with pneumonic infection, a special splinting of the chest wall near the infected area occurred. The fact that so much of the chest was restricted in its respiratory motion during the very early stages of pneumonia seemed to demand such an explanation. Our explanation is that the primary atelec-

tasis involves a considerable portion of the lung, but the lung infection itself is still limited. Should our respiratory muscles be attempting to splint the chest wall against movement, we should expect to find them in a state of contraction. It would be difficult, except by elaborate investigation, to determine the tone of the intercostal muscles, but it should be easy to determine the state of contraction of the diaphragm by the shape of its upper contour.

A state of contraction (splinting) would manifest itself by a flattened, lowered dome, with a narrowing and flattening of the intercostal spaces. We find narrowed intercostal spaces, but the diaphragm on the affected side is generally high and sharply domed. In other words, the chest wall and diaphragm give the impression of being "sucked in." The heart, whether or not dilated from toxemia or pulmonary resistance, is often drawn to an appreciable degree to the affected side. The transverse diameter of the affected chest is generally less than that of the opposite side. If we cannot account for a high diaphragm and apparent lessened chest volume on the basis of old lung and pleural changes, eventration, or intra-abdominal pressure, we can judge the extent of lung collapse from the diminished chest volume. But we must remember that the left diaphragm is normally lower and somewhat more mobile than the right, and that air in the stomach and splenic flexure, large liver, subdiaphragmatic abscess, or abdominal masses, or distention, may displace a diaphragm upward. We can follow the daily increase in the lung density on our X-ray plates, remembering that the entire involved lobe may not, at any time, present a complete consolidation.

What determines the extent of this consolidation may depend upon more than the point of obstruction in the bronchus and the offending organism. The tissue reaction, which is, perhaps, very important, would

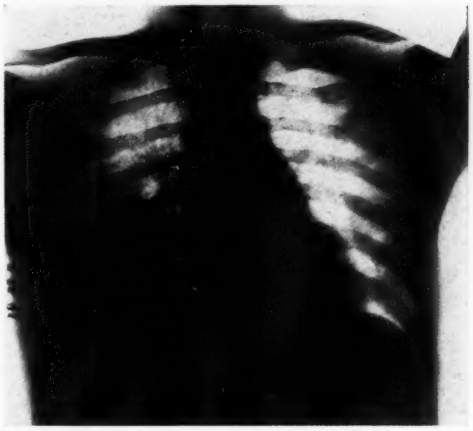

Fig. 1-*B*. Case 1. Film made on July 25, showing great consolidation of the right lung base and clear left chest.

bring forth a consideration of all the elements of the body reactions to different types of organisms. The allergic phenomenon, from a non-specific viewpoint, should perhaps be considered in the exudative reaction. We are sure that certain bronchial obstructions do not lead to pneumonic consolidations.

One cannot but theorize on these cases until more evidence is brought forth to explain events. We have cases in which the roentgenologic evidence of pneumonic exudate is entirely insufficient either to locate or judge the extent of our lung involvement. But the roentgenologic evidence of atelectasis, such as the high diaphragm, the drawing over of the heart to the affected side, and the lessened chest volume on the affected side, all immediately make one fairly certain that we are dealing with an infected atelectatic lung, a pneumonia. Physical examination will generally confirm the contention.

In our consideration of high diaphragm, several facts must be noted. It has been shown that a very high percentage of postoperative cases, regardless of the type of

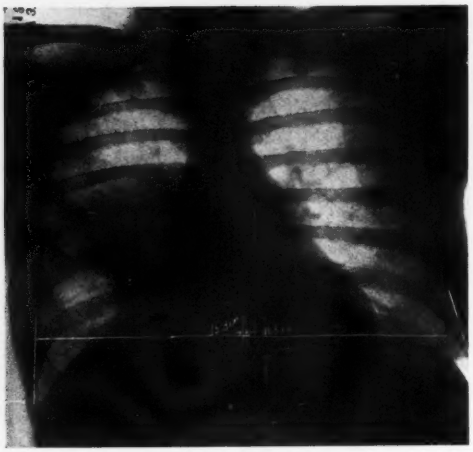

Fig. 2. Case 2. There was little lung involvement and little change in the position of the diaphragm.

operation, show some elevation of one or both diaphragms, usually more on the right side, and most of these are not associated with pneumonic consolidation. Just what proportion of these are due to bronchial obstruction it is hard to state (2). Many consider the condition a partial paralysis of the diaphragm, possibly due to trauma, morphine, toxins, etc. It is, therefore, apparent that a careful consideration of all facts is in order in each case.

A double lung exposure may be made on the same plate, having the patient hold his breath, first in deep inspiration and then in expiration for two exposures. For technical reasons, the exposure during expiration should be of the full chest while the second is only one-half of the normal chest exposure. These will show a decided limit to the diaphragmatic excursion on the affected side. Fluoroscopy, when possible, is a valuable aid. All clinical evidence must be considered in the roentgenologic interpretation.

Here in the semi-tropics, with our uniform climate, pneumonias seem to offer greater diagnostic difficulties than in colder climates. The symptoms may be few and physical findings very uncertain. Cases presenting symptoms of pain and tenderness in the abdomen may be easily misinterpreted, and it is sometimes a question if the so-called post-operative pneumonia was not, in reality, the primary difficulty. In the past it is quite likely that the lack of definite lung clouding in the roentgenographic film in certain cases of atelectasis, which had not developed into full-blown pneumonias, might have led to numerous errors in diagnosis. Our local experience seems to point to the occurrence of such cases in definite series, although our simpler laboratory findings do not indicate that we are dealing with any special infecting organism. Some of the cases have not at any time shown definite clouding in the roentgenographic plate, in spite of the typical clinical picture of pneumonia. It behooves us to consider carefully our indirect roentgenographic evidence of our early pneumonias or the forerunner atelectasis before pronouncing a chest roentgenograph negative. Close attention to clinical findings and other data is most important in the consideration of a doubtful chest.

In the development of pneumonia (3), consolidation extends from the lung periphery toward the hilum, with the base of the triangle at the pleura. This in no way discredits the theories just presented. The pre-consolidation period shows, perhaps, a slight blurring and thickening of the usual markings of the atelectatic lung, but this cannot be detected with certainty. When atelectasis sets in, the usual triangular radiation of lung markings will present a narrowing of the triangle or even a paralleling of the striations. This may give valuable information as to which lung lobe is predestined to consolidation.

Complete bronchial obstruction leads early to partial instead of complete atelectasis, as complete absorption of nitrogen is a very

slow process, which varies with the conditions in the affected lung. This frequently prevents the recognition of the lung collapse from increased lung density alone. With patent bronchi, lung collapse from pneumothorax is often more complete and is easily recognized from increased lung density. This is, however, quite a different condition.

As is exemplified by the cases quoted, we may find roentgenographic evidence of atelectasis only, with the subsequent development of lung plate clouding. We may also have evidence of atelectasis without subsequent lung clouding. In such cases, indirect evidence, substantiated by clinical findings, must be the guide in the interpretation of the chest plate.

Case 1. W. B., male, Portuguese-American, age 21 years, entered Queen's Hospital on July 15, 1931. Nine days before entrance, the patient had begun to complain of generalized aches and pains. He had had severe sweats for four days, but no cough. Physical examination revealed râles at both bases, with hyper-resonance and increased breath sounds at the left base. The diagnosis was pneumonia of the left base.

On July 16, examination of the right base revealed dullness and + V.R.; breath sounds were absent. Râles were heard in the left base. The man, who complained of pain in the right chest, produced typical rusty sputum. Diagnosis was right base pneumonia. The consultant at this time thought both bases were pneumonic.

On July 17 the blood count was 10,050 white blood cells, 72 per cent polymorphonuclears, 26 per cent small lymphocytes.

Direct stain of the sputum showed many pus cells and many Gram-cocci in pairs, a few in chains, some lancet-shaped. Culture of the washed sputum showed numerous minute non-hemolytic green-producing colonies, and Gram-cocci in pairs and short chains.

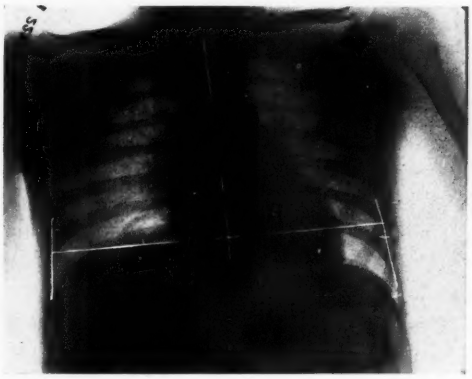

Fig. 3. Case 3. Film made in semi-prone position. Note the elevation of the right diaphragm and dilatation of the heart.

On July 22 the white blood count was 12,500, polymorphonuclears, 78 per cent, small lymphocytes, 20 per cent.

The temperature, which on admission was 100° (respiration 34 – 44) continued moderately high to July 27, then remaining normal, or subnormal, with increased pulse rate.

*Discussion.*—This is a case that illustrates perhaps most clearly what I am trying to prove. The fever, rapid pulse, and respiration, rusty sputum, chest pain, indicated a pneumonia which had not been accurately localized clinically. Without any information except that a pneumonia was suspected, a chest plate, on July 17, with the patient lying almost flat on his back led us to an interesting conclusion. The right chest volume was greatly reduced as compared with the left. The right diaphragm was high. No lung clouding was made out. We were able to report, however, that, although there was no lung clouding seen in the plate, an atelectasis of the right lower lobe was a good probability and that apparently there was developing a right basal lobar pneumonia. The considerable degree of chest collapse indicated also that a large lobe was involved. (This generally means the right lower lobe.) The correctness of

the assumption was proven by the second plate (July 25), which showed a great consolidation of the right lung base and a clear left chest.

Case 2. Mrs. R. K., age 31 years, white. This case illustrates the condition of small lung involvement with very little change in the position of the diaphragm, and very little diminution of chest volume (right middle lobe).

Case 3. K. A., female, age 12 years. The patient presented a typical clinical picture of severe pneumonia. The temperature rose abruptly to 104° and subsided by crisis on the fifth day. The white blood cells were as high as 34,000 with 92 per cent polymorphonuclears. The respiration was 40. The physical examination showed enough evidence to indicate definitely a pneumonia of the right lung base.

The X-ray (portable) film was taken three days after admission, when the patient was semi-prone. While admitting a slight over-exposure here, one cannot but be impressed by lack of the usual findings of pneumonic clouding. The elevation of the right diaphragm and the "toxic" dilatation of the heart are, from the roentgenologist's viewpoint, our only evidence of a possible pneumonia. A second plate, taken three days later, did not show any definite clouding.

This illustrates one of several cases in which, at no time, could a pneumonia be diagnosed from lung clouding in the plate.

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*Carbonic Acid Cause of Earth's Ice Age.*—If the amount of carbonic acid in the air decreased to a half of its present amount, the temperature would fall enough to cause another great ice age on the earth. Calculations showing this were disclosed to the National Academy of Sciences by Dr. E. O. Hulburt, of the United States Naval Research Laboratory.

The small amount of carbon dioxide in the air absorbs much of the heat of the sunlight falling on the earth's surface. A change in the amount of this gas changes markedly the amount of heat retained by the air and, therefore, the average temperature over the earth's surface. Dr. H. B. Maris, also of the Naval Research Laboratory, originated the new theory.

Dr. Hulburt's work was concerned in the first place with calculating the air temperature to be expected from a knowledge of the kinds and amounts of different gases present in the atmosphere at different heights and from a knowledge of how the various constituents of sunlight are absorbed by these substances. The sea level temperature calculated from Dr. Hulburt's formula comes within one degree of the known average earth temperature. This is taken to mean that emission and absorption of radiation are the only processes concerned in the control of the earth's atmospheric heat on the surface. At higher levels mixing by winds interferes with simple conclusions of the theory.—*Science Service.*

# HORIZONS IN RADIOTHERAPY

By HERBERT HOFMANN, M.D., Buenos Aires, Argentina

THE superiority of the gamma radiations of radium in their biologic action, and in their application in the treatment of neoplasms, is well known. Radiotherapeutic apparatus of increasing potentialities and efficiency is constructed for the purpose of attaining as closely as possible the wave length of the gamma rays of radium, and consequently utilizing their physical qualities and biologic effects. The present advances in electric engineering have practically solved the problem of obtaining highly efficient electric apparatus; equipment yielding much more than 600 K.V., with 20 ma., has been tried out and found to satisfy the most exacting demands. But the development of the manufacture of tubes used as X-ray sources has not kept pace with that of other apparatus, and, in daily practice (apart from the experimental field), tubes that will stand more than 400 K.V. cannot be used. Above these limits the life of the tube becomes problematic, and such tubes do not find practical application in radiotherapy.

Indeed, if we observe closely the results obtained with rays having a shorter wave length, we unfortunately have the painful experience of learning that irradiations produced in this way do not agree in any respect with the expectation of attaining a radiation which should be similar in its biologic action to that of radium.

With reference to the topography, localization, and nature of neoplasms, without considering the advantages of the application of radium, without discussing the different biologic values of radiations having different wave lengths, or the amounts of energy administered in the various forms and systems of application, without evaluating their power of penetration and their density, without making any comparison between radium and X-ray radiations, I wish to make the following statement: everyone knows, and the fact cannot be doubted, that the advantages to be derived from the use of X-rays, if their biologic value were as high as that of radium, would be, in addition to greater economy from the viewpoint of their cost, a greater penetration, followed by a wider field of application. Also, with the resulting advantages, it would be more feasible to irradiate larger regions, reaching a greater depth in the action of irradiation.

But, omitting all these considerations, which, relatively, may be possible, and absolutely avoiding even the mention of the immense scope of such a theme, I shall limit myself to the following reflections, so that later on experience may show the error or the exactness of the assertion.

It cannot be doubted that irradiations of catabiotic and consequently of oncolytic power, which are more pronounced, are *soft* radiations (alpha and beta rays). *Soft* radiations can be administered (except in combination with surgery) only superficially, for two essential reasons: (1) their power of penetration is extremely weak, and they are rapidly absorbed by the tissues upon which they fall; (2) before they succeed in acting on the tumor[1] there is produced too intense a catabiotic action on the superficial tissues for their application to be of value in practice. It is principally for these reasons (insufficient penetration and early or late necrosis of the skin) that attempts have been made to obtain increasingly penetrating radiations with X-rays. These rays, which are called hard rays, have, besides the greater depth of their action, owing to their superior penetrative power, a much more

[1] I refer to neoformations that are non-cutaneous and not surgically exteriorized.

marked cutaneous tolerance. By proceeding to the irradiation through various entries, one succeeds in obtaining, at a given point, situated deep down, or wherever it is desired to localize it, the summation of the doses administered, the skin remaining unimpaired. Now, the absorption of rays by the tissues is much less when the hardness of the rays increases. I shall not stop to analyze the various special methods of deep radiotherapy, the advantages and theories of which I omit. I shall discuss what follows from practice: experience has taught us that the biologic value of ultra-hard X-rays is greatly inferior, and that the results of their application are in no way the results expected at the beginning; or, at least, they are not the ones that were to be expected.

An ideal solution would be to make use of the advantages of soft rays from the catabiotic viewpoint, and to use hard rays for the necessary penetration and for keeping the superficial tissues intact. Indeed, the most practical thing is to avail oneself of hard rays (which are penetrating and do not attack the tissues in certain limits and degrees), which, locally, in a given and limited place, become transformed into soft ones, having a high catabiotic value, weak penetrative power, and great absorption.

The question of penetrability is solved with compression and high potentials. Recently an attempt has been made to increase the total mass of the dose employed by shortening the distance between the focus and the skin (Chaoul) in given conditions of protection against high potentials. We consider the problem of potentials solved, but the problem of dosage of radiation varies (Regaud). But the question of the efficacy of a radiation, the biologic value of ultra-hard radiations, is unfortunately less so, as is proved by daily experience. I repeat, then, that the ideal thing would be locally to obtain rays that were soft, the action of which was strictly limited and localized in the tissue which one desired to irradiate, without injuring the other tissues, and keeping the cutaneous integuments intact.

*The solution is to use the well-known principle of dissipation of energy.* We shall use ultra-penetrating rays until the tissue in question is reached, thus being able to avail ourselves of the maximum of energy that is feasible, and completely protecting the tissues traversed by these rays. On reaching the tumor, these hard rays become transformed into soft ones, owing to secondary radiation and characteristic radiation. For that reason we have placed metalloid or metallic substances of varying physical conditions within the tumor. That is, depending on the organ treated, we fill the cavity with a metallic or metalloid solution, or else we place inside of it pieces, bars, needles, discs, moulds, etc., made of various substances. Thus we can fill the cavity of the uterus with iodinated oil, or infiltrate it with colloidal metals, or insert bougies of charcoal or different metals into it. In the case of the thyroid gland (carcinoma, adenoma, or Basedow morbus) we can place from 10 to 20 needles parallel by transfixion, needles of platinum or silver, gold, tungsten, and so on; or else we can infiltrate it with colloidal silver. The bladder may be filled with a metallic or metalloid suspension of Cu, Bi, Ca, C, with colloidal iron, and so on. The technic and the various systems vary infinitely with respect to the organ, the location, the type of tumor, etc. *In situ* we produce secondary rays, soft ones, which originate within the tumor itself, which are absorbed to a maximal extent, and whose biologic value is superior, having besides a penetration completely limited to the place whence they originate; they thus combine, as it were, the ideal conditions for the technic of radiotherapy. Not only are the secondary rays soft, but also their hardness depends on the substance employed (Ca, Au, Ag, Pb, Bi, C, Cu, Fe, Pt, Io, etc.); moreover, we may aspire to succeed in determin-

ing and proportioning the hardness of the secondary and characteristic rays. Thus we have *in situ* an X-ray tube, the rays of which have a short trajectory. Now, the hardness of the secondary rays depends not only on the substance employed but also on the tissue within which the rays originate, on the distance between the focus of the tube and the skin, on the degree of compression, and on the hardness of the primary rays. All these complex factors, the constants and the laws that govern their appearance, must be determined by experiment. The hypophysis may be infiltrated through the sphenoid, to be irradiated then with much greater efficacy than if the ordinary methods had been used. Thus we have a combination of the advantages of hard rays which do not greatly injure the tissues traversed, and the softer local oncolytic rays, localized in a topographic extension determined by the fraction affected, and having a short trajectory and maximum absorptivity; in addition, we have the future optional dosage of the degree of hardness of the radiation and of the local electivity for tissues.

With respect to the technic to be used, it is so variable and the aspects of the variations are so different according to the organ, the localization of the disease, and the substance to use, that it is impossible to describe a definite method free from the individual criterion of the radiotherapist. Furthermore, because there are infinite variations, it is necessary to test even which of the substances are most indicated (Ca, C, Cu, Bi, Fe, Ag, Au, Pt, Io, Al, Pb), and in what physical state they should be used, whether in solution, oil suspension, liquids, bars, needles, or simply in powder wrapped in a small rubber sack, or contained in sounds or catheters.

The future and experiment will give their verdict on the horizons of radiotherapy.

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*New Source of Radium.*—A new source of radium that is expected to break the Belgian monopoly is reported to be in process of development on the shores of Great Bear Lake near the Arctic Circle. Gilbert LaBine, Canadian mining engineer, explored the region by airplane and discovered a black rock which he thought might be pitchblende. Tests at the University of Alberta proved that the ore contained from 100 to 200 mg. of radium to the ton—as much as the best ores in the Belgian Congo. The Canadian deposits are concentrated and easily accessible to the surface, which is not true of those in Africa. Before the development of the Belgian radium in 1922, the United States was producing the bulk of the world's supply from ores found in Colorado and Utah, but the working was discontinued as a result of the Belgian competition. There is at present less than a pound and a half of radium in the world, valued at $70,000 a gram.—*Reprinted from Jour. Am. Med. Assn., May 7, 1932, XCVIII, 1668.*

# MEDICO-LEGAL DEPARTMENT

Reprints Selected by I. S. Trostler, M.D., Chicago

## An "Accident" or "Accidental"

Lickleider *vs.* Iowa State Travelling Men's Association (Ia.), 166 N.W.R. 363

The Supreme Court of Iowa says that one thing at least is well settled: The words "accident" and "accidental" have never acquired any technical meaning in law, and when used in an insurance contract they are to be construed and considered according to the common speech and common usage of people generally. Hundreds of attempts have been made by the courts to define these words in other terms, and while some of them may be regarded as helpful so far as they adhere to popular usage, others have served only to confuse the situation, if not, in fact, grossly to mislead. Certain it is that no attempt in this direction is in any respect an improvement on the definition found in our standard lexicons. It is: "An event from an unknown cause or an unexpected event from a known cause; a thing done or disaster caused without design or intention; an unusual and unexpected result attending the performance of a usual or necessary act."

There is, however, another alleged definition which has had a degree of judicial sanction which ought not to be passed without notice. According to this definition, an injury happening to an insured person through his own voluntary act is not an accident, nor is his hurt to be attributed to accidental means—a proposition that is wholly at variance with every statement of the true rule. It may be, and it is true, that if the insured does a voluntary act, the natural, usual, and to be expected result of which is to bring injury on himself, then death so occurring is not an accident in any sense of the word, legal or colloquial, and it is only when thus limited that the rule so stated has any proper application. It makes no difference whether the injured man or some other person voluntarily sets in motion the first of a series of events which in connected line of causation results in his injury or death. If the resulting injury and violence to him "unexpectedly took place," or was "an unexpected result from a known cause," or was produced "without design or intention," or was "an unusual and unexpected result attending the performance of a usual or necessary act," or was an "event happening without the concurrence of the will of the person by whose agency it was caused," or if it was "caused or produced without design," it falls directly within the letter and spirit of the definition that has been placed on the words by the most competent lexicographers as well as by our most eminent jurists who have given the matter attention.

In this case a holder of a policy or certificate of accident insurance issued by the defendant, in attempting to remove an automobile tire which for some reason resisted his efforts, knelt on one knee, took hold of the casing with both hands, pulling and jerking at it for some time, when it came off with a snap and such suddenness as to cause him to slip or stagger back with the tire in his hands. He immediately turned pale, complained of being very ill, put his hand to his head, and lay down on the ground. Help was called, but he died about an hour later. A postmortem examination was made of the body by three physicians, who found that the immediate cause of death was a blood clot in the right coronary artery near the heart. Two of the physicians attributed the death to arteriosclerosis, while the third found no more arteriosclerosis than is usual

with a man of such size and age. The court holds that a case was made on which the plaintiff was entitled to go to the jury, and that it was error to direct a verdict for the defendant. If the arteries of the insured were sclerotic, but the sclerosis was only such as is the natural or usual accompaniment of increasing years, the fact, if it was a fact, that a bodily injury sustained by him would more likely be fatal than would be the case if such condition did not exist would not prevent a recovery on the policy should it otherwise appear that the injury was of the nature or kind described in the contract.

STATUTE OF LIMITATION: BARRING OF ACTION FOR ROENTGEN-RAY INJURY

Ogg *vs.* Robb (Ia.), 162 N.W.R. 217

The Supreme Court of Iowa affirms a judgment in favor of the defendant that the plaintiff's alleged cause of action was barred by the statute of limitations. The court says it was alleged that in 1901 the plaintiff, then under 17 years of age, broke his right wrist. In July of that year, the defendant called the plaintiff into his office, without the knowledge or consent of the plaintiff's parents, and experimented on him with a roentgen-ray machine to secure films of his hand and wrist. That the defendant continued for ten days in said experiments, and used the roentgen-ray machine on the plaintiff's hand and wrist many times and made long and close exposures. That as a result the skin on the hand and wrist became discolored. That the defendant then informed the plaintiff and his parents that the use of the roentgen-ray machine caused such discoloration, and then falsely and fraudulently informed them that this discoloration was of no particular consequence and would be temporary in its effects, fraudulently concealing from them the true effect of radio-exposure produced by the roentgen-ray machine. That the defendant then treated the discoloration for a time and it apparently disappeared, leaving a scar, but with the usual use of the hand. That the plaintiff and his parents fully relied on the statement and advice of the defendant as to the temporary effect of the roentgen rays, and nothing further was done in regard thereto until 1912. That the use of said machine by the defendant produced a cancerous condition which was latent until 1912, and the plaintiff had no knowledge of said condition until then. That then the tissues of the right hand where the roentgen rays had been applied broke down and became an epithelioma or malignant cancerous growth, which caused great pain and necessitated the amputation of the right forearm. Was the plaintiff's cause of action concealed by the statement of the defendant that the original burning was but temporary and was of no particular consequence, and that the defendant fraudulently concealed the true effect produced by the use of the roentgen-ray machine? The plaintiff alleged that he was burned in 1901 and, as he alleged, by the negligence of the defendant. This fact was known to the plaintiff and his parents. All damages which subsequently developed were traceable to and based on that act. By the original act the plaintiff was injured, and, as the petition alleged, by the negligence of the defendant. He would have been entitled to some damages at that time; and, if it be true that cancer necessarily and in all cases is the result of such burning, or if cancer is the probable result, such fact could be shown as bearing on the question of damages in an action for the original injury. If cancer is not the necessary or probable result of such burning, then the defendant's statement would be more or less of an opinion, and in that case the fact that later and in 1912 a cancerous condition did develop and the plaintiff's damages might thereby be increased, would not constitute a new cause of action. It would seem then that the plain-

tiff's cause of action accrued at the time of the original injury.

ROENTGENOGRAPHS IN BOOK AS EVIDENCE

Chicago, R. I. & G. Ry. Co. *vs.* Smith (Tex.), 197 S.W.R. 614

The Court of Civil Appeals of Texas, in affirming a judgment for $10,000 damages for personal injuries, in favor of plaintiff Smith, holds that there was no error in permitting the plaintiff to introduce in evidence, in connection with the testimony of a physician, certain "roentgenographic pictures" of the bones of the normal foot found in the medical work known as "Treatment of Fractures," by Scudder. The court says that on the cross-examination of the physician he stated that the plates or photographs introduced were to his knowledge correct pictures of normal arches of the feet. He further testified that the book containing the plates was a standard work, accepted by the medical profession generally. It further appeared from the record that the condition of the plaintiff's feet, both before and after the injury, was shown by the evidence. In this state of the record, the plates were certainly not immaterial or irrelevant. Their correctness was established by the evidence of the physician, and, while the predicate for their introduction in evidence was not laid prior to their introduction, this objection was removed by proper subsequent proof.

On the witness stand the plaintiff stated that the condition of his foot "affected his mind, the way being that he got awfully blue at times, when he saw that he could not do as he used to do, and get about as he would like to, and hold the positions that he would want to." It was contended that if he was correct in his statement that his attacks of "blues" and his occasional morbid mental conditions were due to the injury to his feet, still such effects of an injury could not form the basis of a recovery, or enter into the estimate of the damages, according to the rule which prevails in the United States courts. But the court does not agree with that contention. It says that some of the lower federal courts have held that mortification or distress of mind from the contemplation of one's crippled condition, and its effect on the esteem of one's fellows, which is held to be mental pain, separable from the physical suffering caused by the injury, is too remote, indefinite, and intangible to constitute an element of damages in such case. But the statement of the plaintiff clearly did not bring this case within that rule. He made no reference whatever to the esteem his fellows would place on him, or to the mortification attending the realization of the fact that he was maimed, crippled, and disfigured, but stated that his mental condition, which he described as "the blues," was the result of the thought that he could not, since the accident, "get about" and do as he would like to, and hold the positions which he would want to hold. As an element of damages this came within the rule announced in the case of M., K. & T. Ry. Co. *vs.* Miller, 25 Tex. Civ. App. 460, 61 S.W. 978, in which a writ of error was denied by the Supreme Court of Texas.

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# EDITORIAL

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## THE ETIOLOGY OF OSTEITIS FIBROSA CYSTICA

One of the intriguing features of medicine is its ever changing horizon. The etiology of more and more diseases is becoming apparent as the gaps in our accumulated knowledge are bridged. A little over a quarter of a century ago, the first accurate description of osteitis fibrosa cystica was given by von Recklinghausen. Within the past few years, work has been done which has apparently demonstrated its etiology to be of an endocrine nature. This discovery has been prefaced, as usual, by the disclosure of a number of findings by independent workers, which dovetail so that the chain of events would seem to be complete.

The first important event in the solution of this problem took place in 1904, when Askanazy described a case of osteitis fibrosa cystica associated with a parathyroid tumor. Erdheim, in 1907, found parathyroid enlargement in three cases of osteomalacia, but he felt that the parathyroid enlargement was the effect, and not the cause, of the disease. In 1915, Schlagenhaufer proposed the extirpation of the parathyroid tumor in cases of generalized osteitis fibrosa cystica, but it remained for Mandl to operate upon the first patient in 1926. It is of interest to note that he first transplanted additional parathyroids into the patient, and, upon observing a distinct increase in the severity of the symptoms, he removed the transplanted material and a tumor from the parathyroids in the neck. Great clinical improvement followed this operation. In 1925, Hoffheinz reported a very significant study in which he found that, out of 45 cases of parathyroid enlargement recorded in the literature, 27 were associated with bone disease. Of these, 17 were complicated by osteitis fibrosa cystica, eight by osteomalacia, and two by rickets.

In 1925, Collip isolated the active principle of the parathyroid gland (parathormone). Injection of this extract was then shown to elevate markedly the blood serum calcium and to lower the blood phosphorus. The urinary excretion of calcium is also increased many times over the normal. The physiologic effect of parathormone is that of a mobilizer of the blood serum calcium. The work of Hunter and Aub contains ample proof that the source of this mobilized calcium is bone.

From the experimental side, Jaffe, Bodansky, and Blair have recently studied the effects of the administration of parathormone on guinea pigs. By the administration of large doses, they produced destructive lesions in the bone marrow cavity and, if these were severe enough to produce disturbances in the circulation, cyst formation resulted. The authors concluded that these were similar to osteitis fibrosa cystica in man.

The clinical test, applied by parathyroidectomy, has now been made many times, as shown by the reports of Mandl, Hunter and Turnbull, Snapper, Ballin and Morse, Barr and Bulger, and many others. In most cases there was clinical improvement with lowering of the blood calcium. In a number, there was complete or part recalcifica-

tion of the bone lesions; but, in some, the bone changes did not parallel the clinical improvement.

It is important to note that the clinical manifestations of hyperparathyroidism are present only in cases of generalized osteitis fibrosa cystica, while, in the localized type, the figures for the blood calcium and phosphorus are usually normal. Ballin and Morse feel that Paget's disease should be included in the hyperparathyroid syndrome, but many authors, such as Hunter and Schmorl, question this. A number of other bone diseases, having osteoporosis as a characteristic, are mentioned as belonging to this syndrome, but the classification of them awaits more complete chemical and clinical data.

In going over the sequence of events in this story, we find that osteitis fibrosa cystica was described in 1891 by von Recklinghausen. No etiologic lead was obtained until 1904, when a case was found at autopsy associated with a parathyroid tumor. This apparently went unnoticed until 1907, when three cases of osteomalacia, with parathyroid enlargement, were found. It was not until 1915 that it was first proposed that parathyroidectomy should be done in these cases, and 11 more years elapsed before the first case was operated upon (1926). A little earlier (1925) the active principle of the parathyroid glands was discovered. This has made it possible to determine the clinical criteria of hyperparathyroidism and to produce the disease experimentally in animals. Since that time surgeons all over the world have removed the parathyroids in many cases with good results.

Thus it is seen that an association of lesions first found at the autopsy table has been proven by surgical and chemical means to be cause and effect.

HOWARD P. DOUB, M.D.

*Henry Ford Hospital*
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# ANNOUNCEMENTS

## CONFERENCE ON BONE DISEASES

Dr. Joseph C. Bloodgood has sent us the following program of the Bone Demonstration to be conducted in September at the Surgical Pathological Laboratory, Johns Hopkins Hospital.

*Monday, September 19.*—The morning and afternoon will be devoted to X-ray studies of the teeth and the upper and lower jaws. Oral surgeons interested in the diagnosis of lesions in the region of the jaws are especially invited, whether they belong to the medical or to the dental profession.

*Tuesday, September 20.*—Conference (free) of members of the medical and dental professions who bring rare tumors, or tumors difficult to diagnose.

*Wednesday, Thursday, Friday, September 21, 22, 23.*—Diagnostic demonstrations.

The Editor is repeating this announcement, which appeared in the August issue, because this Conference promises to be of especial value to oral surgeons, orthodontists, and all roentgenologists who do any oral work—and we all do.

Anyone wishing to demonstrate a case should write to C. F. Geschickter, M.D., Surgical Pathological Laboratory, Johns Hopkins Hospital, Baltimore, Md.

## NEW TUMOR CLINIC

The new Tumor Clinic Department of the Shreveport (Louisiana) Charity Hospital was recently opened. The unit, which is said to be unexcelled in the South, is equipped with a modern valve tube, 280,000-volt, 30-milliampere deep therapy machine and a shock-proof superficial therapy stand. One hundred and fifty milligrams of radium, distributed in fifty-three platinum and monel needles with accessories, a modern radium work bench with protective booth, a modification of Holfelder's field selector for the charting of patients for deep therapy,

and a complete clinical photographic department, all go to make it the equal of any clinic. Two special pavilions have been provided for housing the patients.

E. L. Sanderson, M.D., Superintendent of the Hospital, is Director and surgeon of the group. O. C. Rigby, M.D., gynecology; I. B. Rougon, M.D., urology; W. S. Kerlin, M.D., medicine; Guy A. Caldwell, M.D., orthopedics; P. R. Gilmer, M.D., chest; Dean Duncan, M.D., neurology; J. D. Woolworth, M.D., eye; L. W. Gorton, M.D., nose and throat; C. B. Erickson, M.D., dermatology; J. R. Matthews, M.D., pathology, and Harold G. F. Edwards, M.D., radiology, complete the group.

## BOOK REVIEWS

LEHRBUCH DER RÖNTGENDIAGNOSTIK. By H. R. SCHINZ, W. BAENSCH, and E. FRIEDL. Third Edition; 1,623 pages, with 2,250 illustrations (cuts) and numerous tables. Published by Georg Thieme, Leipzig, Germany, 1931. Price, 220 marks.

The third edition of this excellent text-book on roentgen diagnosis has been entirely rewritten and revised, 492 pages and 655 illustrations have been added, and the present edition is now published in two volumes. Volume I, consisting of 704 pages, is devoted entirely to the skeletal system and without question constitutes the most comprehensive consideration of the subject available. Volume II is devoted to the other systems of the body. Both sections have been adequately rewritten to include all modern improvements in technic and diagnosis.

This book has become a virtual encyclopedia of roentgenologic diagnosis and as a work of reference is unequaled. The bibliography is unusually complete and includes the significant American literature as well as the foreign. It is unfortunate that the use of this text is limited to those who read German. An English translation would be a most valuable contribution to our literature.

JOHN D. CAMP, M.D.

TUBERCULOSE OSSEUSE ET OSTÉO-ARTICULAIRE. By ETIENNE SORREL, Chirurgien de l'Hôpital Trousseau, Ancien chirurgien en chef de l'Hôpital Maritime de Berck, and MME. SORREL-DEJERINE, Ancien interne des Hôpitaux de Paris. Two volumes of 514 pages and 640 illustrations. Published by Masson et Cie, Paris, 1932. Price, 380 francs.

This two-volume atlas of the roentgenographic changes in tuberculosis of bones and joints is the result of many years of observation by the authors at the Maritime Hospital at Berck Plage sur Mer. As the authors state, this hospital furnishes a large amount of material which may be observed over a long period of time under nearly ideal conditions so far as laboratory studies, roentgenographic observations, and surgical treatment are concerned. The material has been compiled from a study of nearly ten thousand case records, from which the authors have selected examples of the various forms of tuberculous infection. Emphasis has been placed on the types most frequently seen although all forms are included.

Under each subject there is a systematic discussion of the etiology, pathologic anatomy (especially as regards the roentgenographic appearance), symptomatology, diagnosis, and treatment. The illustrations include not only extensive roentgenologic studies but in many instances actual photographs of the patient before and after treatment. These illustrations are well reproduced, the roentgenograms being particularly good in most instances. In many cases diagrammatic sketches of the roentgenograms are furnished. There are some photographs of pathologic specimens but no photomicrographs. To some of us, this omission seems a mistake. While the histologic pathology of tuberculous disease of bones and joints is well known, many cases have been reported as tuberculosis without proof. We do not doubt the authors' diagnoses, but for those of a skeptical nature an occasional photomicrograph would be worth while. Several cases of "spina ventosa" of the long bones of the forearm are instances in point.

The treatment discussed is both conservative and surgical. The surgical procedures

are well described and adequately illustrated. In the knee joint resection, removal of the patella and internal fixation by metallic staple or wire is advocated. In the active tuberculous hip joint an extra-articular type of operation, using a tibial graft between the trochanter and iliac crest, is recommended. Another operation using an osteoperiosteal graft from the wall of the ilium that is moved down on the neck of the femur and beneath the uplifted trochanter, is recommended for old tuberculous disease. For Pott's disease in childhood, conservative treatment up to the age of sixteen is advocated. Beyond this age the majority of cases are considered surgical. The authors illustrate the above types of operations, as well as the Albee, the Hibbs, and osteoperiosteal graft methods.

For a complete text on the subject of bone and joint tuberculosis the authors have produced a remarkable work. It is beautifully printed and illustrated and should enjoy a wide use among roentgenologists as well as those interested in the care of tuberculosis of the bones and joints.

ROENTGENOLOGISCHE BEOBACHTUNGEN UEBER DIE BEWEGUNGEN DER WIRBELSAULE. By SIGVALD D. BAKKE. From the Städisches Krankenhaus "Haukeland," Bergen. Supplementary Volume XIII, Acta Radiologica. Kungl. Boktryckeriet. Published by P. A. Norstedt & Söner, Stockholm, 1931.

This little presentation of 75 pages of text and 24 excellent illustrations printed on fine paper sets forth the results of the author's roentgenologic observations on the movements of the spinal column. The results arrived at are somewhat different from those of other writers. For instance, the author finds that, contrary to the opinion of Professor Fr. Müller, the roentgenologic method holds good in examinations of the mechanism of flexion of the spinal column. The flexibility increases and decreases evenly from vertebra to vertebra along the whole of the spine. There are nowhere any inflexible parts interposed between the flexible parts. This is true of forward and backward bending as well as of lateral flexion.

JAMES T. CASE, M.D.

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*X-ray "Baths" Now Possible for Patients with Tumors.*—X-ray "baths," which irradiate the whole body of the patient for long periods, instead of attacking local spots intensely but briefly, are now available at Memorial Hospital, New York City. They are designed for the treatment of patients suffering from deep tumors. Both the means and the technical knowledge in the development of this special ward were supplied by the late Arthur C. Heublein, M.D., who sacrificed his life to it through illness induced by overwork. The ward consists of four beds arranged about an X-ray machine capable of continuous operation at 185,000 volts and three milliamperes. The patients are kept bathed in its continuous discharge.

It is too early as yet, Dr. Failla said in reporting the new set-up for tumor treatment, to permit the clinicians at the hospital to draw definite conclusions as to the efficacy of the new method. However, some striking results have been obtained in a few cases of generalized radiosensitive tumors, which could not have been obtained by the ordinary methods of X-ray therapy.

H. J. Bagg, Ph.D., also of Memorial Hospital, told of animal experiments performed in this same X-ray "bath." Mice with transplantable tumors have been exposed to the radiation for several weeks, with the result that their life has been prolonged very materially. This has been accomplished without apparent ill effects, since the body weight has remained normal.

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## PELVIS

The Ossification of the Iliolumbar and Iliosacral Ligaments. A. Reisner. Röntgenpraxis, Nov. 15, 1931, III, 1026-1034.

The iliolumbar and iliosacral ligaments are visible in about 3 per cent of roentgenograms of the pelvis. Their visualization does not indicate pathologic changes. In 0.8 per cent, the shadow is marked and in 0.4 per cent, an ossification could be demonstrated. Thirteen cases are described in detail. Definite points for the etiology of this ossification could not be found. The assumption that it might be an abnormal development of the costal portions of the transverse processes is considered improbable. The author explains it by regenerative hyperplastic processes originating in the periosteum. Infectious arthritic processes or injuries may act favorably for the ossification.

H. W. Hefke, M.D.

## PHYSIOTHERAPY

Physical Therapy in Raynaud's Disease. Charles R. Brooke. Med. Bull. Veterans' Administration, December, 1931, VII, 1174-1178.

Raynaud's phenomenon is a vascular change, without organic disease of the blood vessels, seen in the extremities, in which a persistent ischemia leads to a vasomotor disturbance of a varying intensity with impairment of function of the circulation, or to a loss of vitality with ultimate necrosis. The author divides the symptomatology into mild, moderate, and severe types.

The symptoms found in the mild grade of Raynaud's never exceed the usual vascular disturbances seen in chilblains. In the moderate type the symptoms are those of intermittent claudication, tired feeling, cramps in the thigh and calf muscles, and sensations of heat and cold throughout the affected extremity. Headaches, fatigue, lack of energy, and alterations in character also occur as a result of claudication of the nervous centers. In the severe type, pains, swelling, and gangrene of the affected extremities are present.

In the treatment of this condition the author has obtained favorable results with the use of physiotherapy. As the initial treatment, radiant light and heat are used, employing a lamp carrying a 1,000 or 1,500 watt bulb and a good reflecting surface. The lamp is placed over the affected extremity for from 20 to 30 minutes at a distance of from 24 to 30 inches. Instead of this procedure, in some cases the affected extremities should be immersed in a warm whirlpool bath for from 10 to 15 minutes as the initial treatment. Both of these methods should be tried to note which gives the most beneficial results in the particular case. This application should be followed by a 10- to 15-minute treatment of surface high frequency, using a medium size non-vacuum electrode connected to the Oudin terminal of a high frequency machine. If there is swelling, the static brush effleuve should be used for from 10 to 15 minutes to relieve congestion by increasing absorption in and around the affected areas.

Diathermy has been found to be the treatment of choice in the local therapy of the moderate case of Raynaud's disease because of its vasodilator effects on the small arteries and capillaries. The current strength should not exceed 1,000 milliamperes in the average case. The technic depends on the existing conditions, the symptoms present, and the degree of involvement, but as a general rule, the plate and cuff technic has been found to be the most effective. Both upper and lower extremities can be treated at the same time by using a high-frequency chair which is equipped with knobs for each hand to grasp and a foot rest covered with metal for both feet. The diathermy application should be followed by a sedative surface high frequency application.

Systemic treatments should be employed in these cases as an adjunct to the local treatment. General warming of the body is secured in a light and heat cabinet and should be followed by a needle-shower bath. Then, mild Scotch douche sprays should be administered to the entire body. The application of auto-condensation given in the usual way for from 15 to 20 minutes, using a current strength between 500 and 750 milliamperes, has been found of considerable value. Ultra-violet radiations have proved to be beneficial in some cases of Raynaud's disease in which the physical resistance is below par.

J. N. Ané, M.D.

## RADIATION

Radiotherapy in Feeble-minded Children. Wolfgang Freiherr v. Wieser. München. med. Wchnschr., Nov. 6, 1931, LXXVIII, 1904-1908.

In 1911, Bordier reported encouraging results in roentgen treatment of poliomyelitis anterior. Many others confirmed these results. Babinski and Delherme successfully treated myelitis due to pachymeningitis traumatica. It was only through the paper of Heidenhain and Fried that these results could be explained by the action of the rays on inflammatory tissue.

The author has extended the field by radiating all brain conditions which were due to inflammation. This includes disturbances in the function of the cerebrum due directly to inflammation or trauma or functional disturbance of the inner-secretory gland system. Best results were seen in mongoloid children, in which 80 per cent showed good improvement. Other conditions were dysgenital imbecility, epileptic dementia, and conditions resulting from encephalitis and meningitis. It is of little importance, what the symptoms are of a disease to be treated, as long as the underlying condition is understood. The dosage varies according to the individual case and ranges

between one-twentieth and one-third of an erythema dose.

ERNST A. MAY, M.D.

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Roentgen Treatment of Agranulocytosis. Albert E. Taussig and Paul C. Schnoebelen. Jour. Am. Med. Assn., Dec. 12, 1931, XCVII, 1757-1761.

Werner Schultz defines this disease as "an acute febrile disease with angina, prostration, and jaundice, a normal red blood picture, extreme leukopenia with almost or quite complete absence of granulocytes, a normal number of blood platelets, with absence of any tendency to hemorrhage, and an invariably fatal ending." Cases were reported lacking one or more of these cardinal symptoms. Agranulocytosis is characterized by fever, usually but not always by ulcerative processes, leukopenia with great diminution of the granulocytes, and nearly normal blood platelets. At autopsy a very characteristic change is found in the bone marrow, consisting in a great paucity of the myelogenous white cells, which are also absent, or nearly so, in any inflammatory foci that may occur.

A myelopathy occurring in the course of antisyphilitic treatment, most frequently after the use of one of the arsphenamines, was known for some years before Schultz's agranulocytosis was recognized. The metallic poison depresses all the functions of the bone marrow, adding an anemia, often extreme, and a sharp reduction in the blood platelets with a resulting tendency to hemorrhage. This offers a much more favorable prognosis than true agranulocytosis. Cases of agranulocytosis have been repeatedly observed to pass over into acute lymphatic leukemia.

Friedemann reported a large proportion of all cases treated by means of the X-ray. His mortality, excluding moribund patients, was 48 per cent. Other observers had a mortality of 57 per cent, and the authors, 50 per cent.

Transfusions and roentgenotherapy are useful in the treatment of agranulocytosis, irradiation of the long bones giving the better results.

CHARLES G. SUTHERLAND, M.D.

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## RADIATION INJURIES

The Cause and Prevention of Radiodermatitis. H. H. Hazen. Jour. Am. Med. Assn., Dec. 19, 1931, XCVII, 1881-1885.

This is a study of 111 cases, following the application of either X-rays or radium. Three resulted from the taking of roentgenograms; thirteen from high voltage therapy; seven occurred in roentgenologists; thirteen were from treatments received in beauty shops; the remainder, or seventy-five, from superficial therapy. Ninety-seven showed signs of injury before the expiration of twelve months, and an additional eight before two years had elapsed. Four showed nothing for three years, and in two the first signs of trouble appeared after forty-eight months. There are a few cases on record in which the appearance of telangiectasis has been delayed even beyond four years.

Tables show the location of the radiodermatitis and character of injuries, conditions for which treatment was given, and types of cases resulting in serious keratoses. Many patients suffering from comparatively benign conditions were among those most seriously damaged. Another table reviews the causes of the lesion.

C. G. SUTHERLAND, M.D.

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## RADIUM

Non-destructive Testing by Gamma Rays from Radium. Robert F. Mehl. Jour. Am. Soc. Naval Engineers, August, 1931, XLIII, 371-395. (Reprinted by permission from "Metals and Alloys.")

The author describes the apparatus used by the Naval Research Laboratory and discusses experiments carried out on steel castings. A large number of photographs and radiographs are presented, showing the results obtained. It is inevitable that this new method of radiographic inspection should be compared with the X-ray method. This new method offers advantages in greater simplicity of operation, almost complete portability, far greater penetration, and more satisfactory performance on irregular sections. It suffers from the rather longer exposure times and from the lack of general availability of radium. The cost of an inspection method is naturally of very great interest to industry and before it can be claimed that this new method will have a wide application, it will be necessary to show that its costs are not prohibitive. Such surveys as have been outlined in this paper, however, indicate that a sensible prosecution of the method industrially should result in costs which are well within the admitted range of inspection costs. It is of interest to note that the Navy has considered the matter carefully and has decided to provide the Navy Yards on the East Coast with radium for this purpose. This radium will be held at the Naval Research Laboratory. The total amount will be one-half gram divided into three portions, so that separate portions can be sent to the various Yards as required.

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Radiotherapy in Basedow's Disease. Halberstädter. München. med. Wchnschr., Dec. 25, 1931, LXXVIII, 2189, 2190.

All of the six patients who died in coma after radium application in Basedow's disease had such severe complications that it is impossible to state exactly whether or not the radium applications had made the condition worse. It may be said that apparently three cases were aggravated by the radium.

The doses were very small and similar to the ones used by others. At any rate, the condition of all six patients was such that any kind of treatment or other outside influence might have resulted in coma. To avoid all doubt, the author suggests that we remember that extreme cases may react by increased symptoms. He advises either giving the patient an almost fictitious treatment, or an initial treatment of the spleen or thymus in order to learn what the psychic or physiologic reaction of the patient may be in each case.

ERNST A. MAY, M.D.

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Roentgen Carcinoma Cicatrized by Radium. A. H. Roffo. La Prensa Méd. Argentina, Nov. 10, 1931, XVIII, 742-751.

The author presents the case of a well-known radiologist, Lucio O. Aravena. He gives a short résumé of the literature on the subject and concludes that he does not understand why physicians are afraid to use radium in such cases. He also wonders why they will make use of surgery when the results are so unsatisfactory. He states that when epithelial cells have reached a neoplastic state, they acquire a new biologic state which gives them a special characteristic—that of malignancy—regardless of the etiologic factor. The belief that roentgen cancer gives a different reaction to irradiations has cost many lives and much loss of time.

In the case that he presents, the author instituted radium therapy, resulting in a few days in the disappearance of agonizing pain. In two months the multiple lesions, all ulcerative and two very deep, were replaced by scar tissue. He concludes by introducing a letter written by the radiologist-patient, giving an outline of the many years he had suffered, the evolution of the lesions, and their final cure with the radium.

N. G. GONZALEZ, M.D.

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## RICKETS (THERAPY)

Irradiated Milk: The Energy Requirements for Antirachitic Activation. G. C. Supplee, M. J. Dorcas, and Alfred F. Hess. Jour. Biol. Chem., 1932, XCIV, 749-763.

Physical data indicating the character and the amount of radiant energy required for the antirachitic activation of milk are presented and coordinated with the biologic and clinical tests. The irradiation of the milk was carried out in 1,000-pound lots under commercial conditions which permitted a precise study of various factors. With a suitable quality and quantity of radiant energy applied under uniform conditions, the antirachitic and calcifying properties of milk can be regularly increased within a few seconds, as determined by biologic laboratory assays and clinical tests on infants. This high degree of activation is obtained without the development of adverse secondary reactions which may occur after long periods of exposure.

The energy of the radiations from a suitable C lamp of the flaming arc type and a $SiO_2$-Hg vapor lamp confers definite antirachitic and calcifying potency on milk treated according to the technic described. However, the spectral energy characteristics of the radiations from the C arcs are readily subject to control, both as to the quality and quantity of the energy. Milk irradiated under controlled conditions and subsequently dried by the Just process was found to protect even colored infants from rickets during the winter months. Such milk also manifested definite curative value in a number of cases.

CHEMICAL ABSTRACTS.

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An Investigation of the Comparative Ash Contents of the Metaphyses and Shafts of Bones. Alfred H. Hess, Frieda S. Berliner, and Mildred Weinstock. Jour. Biol. Chem., 1931, XCIV, 9-19.

Determinations of ash show that osteoporosis of the shaft accompanies rickets in rats and runs parallel with the loss of ash in the rachitic metaphyses. In the course of healing, not only is the absolute amount of ash deposited in the metaphyses greater than that deposited in the shaft, but calcification of the metaphyses proceeds at a more rapid rate than in the shaft. The bone ash of normal older rats is higher than that of younger rats, whereas the inorganic P of the serum is lower in the older rats. The deposition of as little as approximately 1 mg. of ash when laid down in the rachitic epiphysis can be noted by X-ray film.

CHEMICAL ABSTRACTS.

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## ROENTGEN-RAY (INDUSTRIAL APPLICATION)

New Applications for the X-ray are Continuously being Discovered. Don S. Brown. Electric Journal, February, 1931, XXVIII, 88-90. (Reprinted by permission from "Metals and Alloys.")

This is a review, indicating the applications of the X-ray to the medical, therapeutic and industrial fields, arts, and sciences. X-rays have been used to detect flaws and blow holes in castings; to inspect welds and insulated electric conductors; to check the workmanship of complex mechanical assemblies, such as shells; to detect impurities in sugar and flour; to determine the amount of ash in coal, and the proportion of fat to lean in canned beef, etc.

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The Use of X-rays in the Study of Pearls. B. W. Anderson. British Jour. Radiol., 1932, V, 57-64.

Oriental pearls and cultured pearls show different Laue diffraction patterns in the X-ray beam. Photographs are given of diffraction patterns for both types of pearls and of certain crystals.

CHEMICAL ABSTRACTS.

## TUBERCULOSIS (DIAGNOSIS)

Fourth National Congress in the War against Tuberculosis (Bologna, October, 1931). The Onset of Pulmonary Tuberculosis in the Adult. A. Gasbarrini. Il Giornale di Tisiologia, Dec. 31, 1931, 237, 238.

The importance of the fight against tuberculosis in all countries impels physicians to recognize the disease at the earliest possible moment. In place of the old doctrine of an insidious, gradual, and slow invasion of pulmonary tuberculosis in the adult, there has been substituted of recent years the concept of an acute start and development.

The recent roentgenologic acceptance of the so-called apical infiltrate by Assmann and the resulting studies of Redeker have strengthened this view and have aroused heated discussion regarding the genesis of the infiltrate. In addition to the apical theory, we have the conception, recently revived by Italian investigators, according to which, in processes of tuberculous reinfection, great importance is to be attributed to the lymphatic glandular system. The disease, starting thus in the glands of the hilus, is believed successively to invade the pulmonary parenchyma by a retrograde course in all directions, at one time in the neighborhood of the hilus, at another along the interlobular spaces, again, and by preference, in the infraclavicular region, and finally in the apex. Hence, when the pulmonary apex is seen to be involved, the first manifestation (clinical and radiologic) does not coincide with the initial localization of the tuberculous process, but marks a late stage in the course of the disease evidenced by the infection which started in the glands of the hilus. The infiltrate of Assmann represents, therefore, the second, not the first stage, as claimed by Redeker.

Roentgenographic examination (particularly fluoroscopic), even though most accurate and carried out with perfect technic, does not always succeed in revealing the most delicate structural alterations, especially of the apex. Accordingly, roentgenographic findings must be interpreted with the greatest caution, as certain images cannot always be referred to parenchymal foci. Roentgenologic investigation is most uncertain when it is a question of interpreting the density of the shadows in the region of the hilus and the so-called striæ of Sturz, since Busi demonstrated that there does not exist in the adult a hilus of normal type and that the term "peribronchitis," taken in the sense of "lymphangitis," has been subject to abuse. Besides, roentgenologic investigation gives us no, or little, information, regarding the activity of the lesion. Roentgenologic examination, therefore, should always supplement objective examination but should never be a substitute for it.

W. W. Whitelock, Ph.D.

The Roentgenologic Diagnosis of Lymphogranulomatosis and Tuberculosis. M. Werner. Röntgenpraxis, Dec. 15, 1932, III, 1114-1116.

Tuberculosis of the lungs and hilus glands may occasionally be mistaken for Hodgkin's disease. Roentgenograms of the case described showed a large glandular mass in the right hilus, with infiltration extending from it into the lung, this being considered typical of Hodgkin's disease. A biopsy of enlarged cervical glands was diagnosed as probable lymphogranuloma. Sputum examination did not show tubercle bacilli. After roentgenotherapy the tumor decreased in size, which was also considered a sign of Hodgkin's disease. An autopsy, however, showed no evidence of lymphogranuloma, but only tuberculosis of the lungs and glands.

H. W. Hefke, M.D.

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Feminine Sterility and Tuberculosis. Vital Aza. Rev. Méd. Cubana, December, 1931, XLII, 1490-1503.

About 18 per cent of sexual unions remain sterile due to feminine incapability. The cause of 60 per cent of sterility in women is the gonococcus. Of the remaining 40 per cent, tuberculosis of the adnexa is the prime offender.

In the uterus there are two types of tuberculous infection: (1) The ulcerating, and (2) the vegetating or papillary type. The author believes that many of the brilliant surgical or roentgenologic results in cancer of the neck of the uterus are due to the fact that such lesions are tuberculous and not cancerous. Many cases of sterility are probably due to a metritis, having its origin in a tuberculous infection, though such a condition does not necessarily cause sterility. The most common site for genital tuberculosis is the fimbriated ends of the fallopian tubes and the result is an occlusion of the tubes with consequent sterility. Many times, the infection progresses and invades the ovaries from the tubes, sometimes even involving the peritoneum. Many authors claim that from 85 to 90 per cent of tuberculous peritonitis occurs in women, the reason being that the male genital organs are extra-peritoneal.

The author goes into great detail concerning the symptoms and clinical findings of the disease, and in regard to the treatment, he states that surgery cannot restore function, but can usually cure by means of extirpation of the involved organs. He has obtained excellent results with radiotherapy.

N. G. Gonzalez, M.D.

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Roentgenologic Aspects of Childhood Tuberculosis. Benjamin Goldberg. Am. Jour. Roentgenol. and Rad. Ther., September, 1931, XXVI, 397-407.

The "childhood type of tuberculosis" is the term given to the first infection by the tubercle of a small

area of lung structure with secondary hilus lymph node involvement. This may occur in infancy, at any age of childhood, or even in adult life. Too often the clinician is tempted to make the diagnosis on indefinite physical signs plus a positive tuberculin reaction; the roentgenologist likewise may give an opinion of tuberculosis on indefinite hilus changes.

It is the author's opinion that only a careful correlation of history, physical signs, laboratory tests, and X-ray findings make for an accurate diagnosis. Physical findings are quite variable and usually inconclusive. A negative tuberculin test only when properly done and upon repetition found again negative may be considered positive evidence against tuberculosis, although the author admits that cachexia, grave tuberculosis, measles, pertussis, and scarlet fever may reduce or abolish allergy; hence, in such cases, only a negative skin reaction can be expected. Likewise a positive test merely indicates a hypersensitiveness and does not prove the presence of a chest lesion.

The roentgenologic evidence may be of greatest help or greatest hindrance in a correct diagnosis, dependent upon the skill and care of the examiner. The primary tubercle (Ghon tubercle) is usually subpleural and more often in the right lower than left lower or upper lung field. This original focus may not be demonstrable unless of sufficient size and calcified or associated with an area of caseation. The associated hilus involvement likewise varies greatly and may produce changes not sufficient to be detected, or large dense caseating gland masses, easily seen, may be present.

Miliary tuberculosis in infancy or childhood may give a rather characteristic mottling, or if the tubercles are small and not associated with appreciable coalescence, the roentgen findings may be negative. Epituberculosis, a specific infiltration of a large area of lung tissue, may be considered a form of allergy reaction; this condition will, of course, produce roentgen changes, but these may be so dense as to obscure the primary focus and merely indicate the presence of a pneumonic consolidation or area of atelectasis. The apical form of tuberculosis occurs occasionally in older children, and clinically and roentgenologically it resembles the same type in the adult. The author believes that the history, physical findings, and laboratory evidence should be available to the roentgenologist at the time of the roentgenologic interpretation.

J. E. Habbe, M.D.

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Roentgen Diagnosis of Tracheobronchial and Pulmonary Tuberculosis: Its Value. Merl L. Pindell. Calif. and Western Med., February, 1932, XXXVI, 81-87.

In this paper the author discusses the methods used in the Los Angeles County Health Department in the early discovery of pulmonary tuberculosis. He also discusses the significance of roentgen diagnosis. The physical findings may not demonstrate pulmonary tuberculosis, even though it is present. Definite parenchymal changes are seen in nearly all X-ray films of proven pulmonary tuberculosis. The absence of such changes demands other proof of the existence of the disease. The insurance companies could save thousands of dollars and be of greater benefit to mankind by including X-ray examination of the chest in their medical examinations.

In an examination of 197 high school children, 30 per cent of whom were known to have had contact with tuberculous patients, only two cases of pulmonary tuberculosis were found. One of these had no clinical symptoms or physical signs, the diagnosis being made with the X-ray alone. Clinical symptoms and underweight are more or less common to non-tuberculous children.

The writer believes that the X-ray is the only reliable method of diagnosing tracheobronchial tuberculosis. He considers all enlarged intrathoracic lymph notes in a child as tuberculosis.

"The only time that tuberculosis has a marked tendency to heal is in the earliest stages, when it is localized; therefore, this is the time at which it should be diagnosed, and the X-ray ranks supreme in showing these early lesions. There is no secret in the accuracy with which the X-ray depicts dense tuberculous lesions, but there is probably an art in being able to distinguish slight, fine, tuberculous mottling in the lung from the normal lung markings. Roughly speaking, any confluent densities or discrete, fine mottling, or coarse nodular infiltration in the upper half of the lungs of an adult should be considered tuberculous until proven otherwise. These markings must be entirely distinct from the linear markings of the lungs. Most of the lesions located in the lower half of the lungs should be considered non-tuberculous until proven otherwise. But many times characteristic nodular densities are observed in the bases and, of course, represent tuberculosis."

The author believes that the disease is not arrested so long as the X-ray shows densities not completely fibrosed or calcified. When the X-ray shows characteristic infiltration not completely fibrosed or encapsulated, the patient is still in a dangerous condition and should be treated.

It requires a great deal of experience to properly interpret X-ray films. The author believes that many physicians try to read too much into the film. All children that are contacts or have a possible tuberculin reaction should be roentgenographed. The time has arrived for the public to demand X-ray examinations of the chest, when applying for periodic examinations.

Francis B. Sheldon, M.D.

## TUBERCULOSIS (THERAPY)

Phrenicectomy in the Treatment of Pulmonary Tuberculosis. G. Gullotta. Archivio Italiano di Chirurgia, November, 1931, XXX, 361-392.

After tracing the history of resection of the phrenic nerve in the surgical treatment of pulmonary tuberculosis and describing the method of procedure, indications, and effects, the author presents a series of tables founded on clinical and radiological observations showing the results of the operation in 42 personal cases. Indications for the intervention cover a fairly wide field. On the basis of the encouraging results obtained, the author recommends this mild operation, which is made without special preparation, as an effective weapon under certain conditions against pulmonary tuberculosis.

W. W. Whitelock, Ph.D.

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Indications for Radical Surgery in Tuberculosis of the Kidney. Alfred I. Folsom. Urol. and Cutan. Rev., February, 1932, XXXVI, 75-79.

While tuberculosis of the kidney has for a long time been considered a purely surgical condition, an effort has been made to revive the medical type of treatment. In 1924, Medlar established the fact, from experimental work on guinea pigs and rabbits, that whenever an actual bacilluria existed, there was in every case a definite lesion of the renal substance. This lesion was sometimes microscopic in size and could in some instances be found only by careful serial sections, but in each case the lesion was definitely demonstrated. This work of Medlar emphasized the difficulties of an early clinical diagnosis, and the fact that before a tuberculous lesion of the kidney can be diagnosed it must have reached a fairly well-developed state. At this advanced stage the lesion, as a rule, will produce a definite diminution of the kidney function or some change in the kidney that will be recognized by a modern roentgen examination of the urinary tract.

The roentgenologic findings in this condition are as follows: Irregular calcified deposits in the cortical or medullary lesion, which are fairly distinctive and may be proved by a pyelogram to be outside the pelvis; in the pyelogram a ragged or moth-eaten appearance of the margin of one or more of the calices, with or without dilatation; characteristic multiple narrowings of the ureter, as seen in the ureterogram; complete or partial obliteration of the whole or a part of the kidney pelvis. A kidney showing these changes becomes at once a definite clinical entity.

The symptomatology of tuberculosis of the kidney is often confusing, for there are no characteristic symptoms of this condition, the outstanding one usually drawing the attention of the urologist from the kidney to the bladder. The author agrees with Cabot, Casper, Rovsing, and others that a diagnosis of clinical tuberculosis of the kidney cannot be made on the finding of a few tubercle bacilli in the urine. For this reason, they believe that a kidney should never be removed until more substantial evidence is present to convict it.

While the majority of clinical surgeons are of the opinion that, in the largest number of clinical cases of tuberculosis of the kidney, the condition is unilateral, Medlar, Thomas, and Kinsella believe that the disease is usually bilateral. However, the author expresses the view that the renal tuberculosis produced experimentally by Medlar does not correspond to a chronic renal tuberculosis, but to an acute miliary tuberculosis. Similarly, the autopsy findings of patients who have died of tuberculosis are often a manifestation of a terminal miliary tuberculosis. Some authors report the existence of bilateral renal tuberculosis in from 88 to 100 per cent of cases, while others consider that 12 per cent represents the occurrence of bilateral lesions in this condition. It is the author's opinion that two entirely different pathologic entities are considered by these investigators. He points out the fact that in reviewing Medlar's 30 autopsy cases, in spite of a generalized tuberculous infection, he found not a single case of caseo-cavernous tuberculosis. Likewise, in spite of numerous small lesions occurring in the 60 kidneys, in individuals debilitated by a generalized tuberculosis coming to autopsy, there was not one case in which any of the clinical evidence of tuberculosis of the kidney was present.

The author concludes that it is his opinion that once a clinical diagnosis of renal tuberculosis is made, the one and only rational procedure is the removal of that kidney, as soon as possible. However, the remaining kidney should show a normal capacity to excrete indigo carmine or phenolsulphonphthalein, and the urine from this kidney should be cytologically clear.

J. N. Ané, M.D.

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## TUMORS (DIAGNOSIS)

The Diagnosis of Lung Tumors. Richard Epstein. Röntgenpraxis, Dec. 1, 1931, III, 1057-1062.

The number of symptoms, which are supposed to be characteristic for bronchial or lung tumors, is large. Some of them can be depended on only to a small degree. The most important diagnostic means are: roentgenograms, bronchoscopy (biopsy), bronchography with iodized oils, and pneumothorax. A roentgenologic examination should be done in all questionable cases, it being of greatest importance, also, in all cases with a primary tumor in another location, in order to determine the presence or absence of lung metastases. Rather often surgical removal is attempted when a roentgen examination would have shown metastases in the lungs.

H. W. Hefke, M.D.

## TUMORS (THERAPY)

Roentgenography in Brain Tumors: Its Value and Limitations without Ventriculography or Encephalography. J. Gershon-Cohen. Am. Jour. Roentgenol. and Rad. Ther., September, 1931, XXIV, 414-427.

This study is based on 221 cases of brain tumors, with microscopic pathologic diagnosis made either following operation or at autopsy. Ninety-seven cases were in the cerebrum, 65 in or around the pituitary fossa, and 59 in the cerebellum.

In the 65 cases of pituitary body or suprasellar tumors originating from the pituitary body 58, or 89 per cent, gave localizing roentgen signs. The important roentgen signs and their frequency of occurrence in this series were: Alteration in size and shape of sella, 90.8 per cent; atrophy of the dorsum sellæ and posterior clinoid processes, 80.5 per cent; atrophy of the anterior clinoids, 7.7 per cent, and erosion of one side of the sella, 6.2 per cent.

In the 97 cases of cerebral tumors 55, or 56 per cent, were diagnosed from the plain roentgen examination, 26 cases showing localizing signs. Localizing signs and their frequency of occurrence were: Calcification within the tumor, 11.3 per cent; local bone atrophy, 12 per cent; local bone hyperostoses, 6 per cent. Diagnostic signs due to increased intracranial pressure were: Atrophy of the dorsum sellæ, 30 per cent; convolutional atrophy, 11 per cent, and prominence of the diploic channels, 16 per cent. It was observed that in this group the glioma, occurring most frequently of all cerebral tumors, showed no roentgen evidence of its presence in 59 per cent of the cases and underwent calcification with resultant localization in only four cases.

Of the 59 cases of cerebellar tumors only 50 per cent gave positive findings, with only two showing definite localizing signs in the nature of local bone atrophy. Whereas the cerebral tumors showed convolutional atrophy in only 11 per cent in cerebellar tumors (because of earlier obstruction to the fourth ventricle or aqueduct of Sylvius), convolutional atrophy was demonstrable in 30 per cent of the cases. Atrophy of the dorsum sellæ was present in 22 per cent, and diastasis of the sutures, in 10 per cent.

The routine radiographic study consisted of stereoscopic right and left lateral, single antero-posterior views, and a lateral 36-inch teleoroentgenogram of the pituitary fossa. In recent years in addition to the above views, a view of the posterior and middle fossæ for study of the superior ridge of the petrous bones has become part of the routine, but the results from this additional projection are not included in this study.

J. E. Habbe, M.D.

The Theoretical, Experimental, Clinical, and Economic Foundations of Protracted Fractional Roentgenotherapy of Malignant Tumors. H. G. Zwerg. Strahlentherapie, Feb. 10, 1932, XLIII, 201-248.

In the introduction the author discusses the theory of the protracted fractional dose method as it has been developed from our knowledge, concerning the biologic effect of roentgen rays on normal and tumor cells. He then presents a detailed report of his own experiments, undertaken in order to determine the rôle played by subdividing the dose and also by protracting it. The skin, white blood count, lung tissue, heart muscle, and kidney reactions were studied in this connection, rabbits being used in all tests.

The technic was as follows: 180 K.V., 4 ma., for protracted treatment, 3.3 mm. Cu + 1 Al; for simple fractional method, 0.5 mm. Cu + 1 Al, half value layers in Cu 2.8 mm. and 0.8 mm., respectively. The daily dose amounted to 180 r, which was reached at 40 cm. F.S.D. in 7½ and 30 min., respectively. The total dose varied between 5,600 and 9,200 r. The animals were killed from one-half to 10 months after the treatment.

From a study of the skin reactions on the back of rabbits it appeared that neither macroscopically nor microscopically was there any difference between animals which were treated by the protracted fractional method and by the fractional method alone. There were no injuries following the application of doses up to 5,600 r, no changes in the blood vessels, and no proliferation in the connective tissues. After such a dose was given in one sitting, necrosis occurred. Degeneration in cell nucleus and in the cell plasma appeared, if there was less subdivision of the total dose than indicated above. If the total dose was increased to 9,600 r, slight injuries were observed and here again the subdividing of the dose was more important than the protraction of the treatment. The study of the leukocyte changes led to a different conclusion. In this case there was a definite variance between the animals treated by fractional doses alone and those treated by protracted fractional doses. The injurious effect was definitely less if the dose was both subdivided and protracted. The same deductions could be drawn from the histologic studies of irradiated lungs. The protraction introduces apparently a great safety factor. The heart muscle proved to be rather resistant to X-rays. A total dose of 7,000 r did not produce definite damage. There was no difference between simple subdivision of the dose and the protracted fractional dose method. A very marked difference between the reactions produced by the two treatment methods was seen in irradiated kidneys. Simple subdividing of the dose produced almost as severe reactions as 400 per cent E.D. applied in one sitting. The protraction is, therefore, of great value as far as irradiation of the kidney is concerned.

The author then discusses the clinical value of the protracted fractional dose method by briefly analyzing the reports available so far in the literature. He then briefly quotes 10 cases of his own which led him to the preliminary conclusion that the application of this treatment method undoubtedly may show results where other methods or means of treatment will fail. From the characteristic reaction produced in mucous membranes, which is so different from the reaction following the single application of a high dose, the principal difference between the protracted fractional dose method and other treatment methods can clearly be seen. It is also most interesting to note that in spite of the high total doses administered, only in rare instances do patients develop X-ray sickness or lose weight. It is necessary, however, to carefully observe the cardiovascular system, since definite disturbances appear following the application of large fields. They manifest themselves in lowering of the blood pressure, tachycardia, and arhythmia. In one of the author's cases death occurred under the typical symptoms of lung embolus. Although this was not proved by autopsy, the author is inclined to see a definite relation between irradiation and death. It is also necessary, of course, to protect kidney, liver, spleen, intestines, and bones as much as possible.

One very important consideration of the protracted fractional dose method is the economical side. Since it takes considerable time to treat one patient, only a very small number of cases can be treated per day. The cost of the procedure is naturally high. At the present time it can be carried out only in institutions in which several machines are available. A most complete bibliography concludes the paper.

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Results of Protracted Fractional Roentgentherapy in Malignant Tumors. A. Zuppinger. Strahlentherapie, April 13, 1932, XLIII, 701-718.

The author reports 20 cases of malignant tumors, treated by the Coutard method, which were free of symptoms for at least one year at the time of writing the report. Exposure was usually over two or three fields. The doses in air amounted to from 150 to 200 r per sitting, which were applied in from 48 minutes to two hours. For economical reasons the latter period was finally reduced to one hour. Some patients received total doses of 7,000 r. In 19 out of 20 cases the diagnosis was confirmed histologically. There were 18 carcinomas and 1 sarcoma. In only 4 cases would surgery have been possible; however, a most radical and mutilating operation would have been necessary. In 2 cases radium had to be used in addition to roentgen rays, and in 2 other cases surgery, in addition to irradiation.

From the analysis of the cases the author concludes that the chances of cure depend chiefly on the type of metastases and secondly on the extension of the primary tumor. The general condition of the patient and the histologic structure of the tumor play extremely important rôles. Very definite indications must be observed, in order to treat only suitable cases with the protracted fractional dose method.

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## ULCERS (ETIOLOGY)

Neurogenic Factor in Chronic Peptic Ulcer. Witten B. Russ. Jour. Am. Med. Assn., Nov. 28, 1931, XCVII, 1618-1620.

The etiology of peptic ulcer and its pathogenesis are yet to be determined. Most observers admit there is some predisposing cause yet unknown. The ulcer-bearing individual belongs to a distinct type and from birth is predisposed to the development of chronic peptic ulcer. This type is the high strung, emotional, so-called vagotonic individual, with a sensitive nervous system and certain physical peculiarities which clearly distinguish him from the opposite or sympatheticotonic type, showing marked visceroptosis and being subject to melancholia, lassitude, headaches, and atonic constipation. Many observers have emphasized the importance of the nervous element in the production of ulcer. It is a well-known fact that patients resistant to treatment by rest, diet, and alkalies often recover completely and suddenly from their symptoms when they are made happy by some occurrence, change of residence or occupation.

Both experience and common sense point to the conclusion that the mystery connected with the origin and behavior of chronic peptic ulcer is in some way related to the patient's nervous organization and his physical make-up.

CHARLES G. SUTHERLAND, M.D.

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